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Naval Ocean Research and
Development Activity
NSTL Station, Mississippi 39529

Hydrographic Information Handling System (HIHAN) Concept Development

Prepared for:
NORDA Code 550 Mapping, Charting and
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Sponsored by:
Defense Mapping Agency

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PREFACE

The main elements of this document are background information describing present NAVOCEANO hydrographic systems, attributes sought in the HIHAN concept, a proposed logical or functional design concept based on structural analysis, and a scenario describing tasks NAVOCEANO undertakes in response to survey requests.

The overall HIHAN project is sponsored by DMA under program element 63701B, "Hydrographic Information Handling (HIHAN) System for Automated Smooth Sheet Production," and managed by LCDR Victor Hultstrand, NORDA Code 550, Mapping, Charting and Geodesy Program Management Office. The DMA Program Manager is LCDR J. Brodie. Mr. George Dupont, Mr. Morris Heinzen, and Mr. Lou Robertson of NAVOCEANO were primary contributors from the operational point of view.

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1. INTRODUCTION

The HIHAN (Hydrographic Information Handling) System will consist of the software/hardware needed for the operator/hydrographer to process hydrographic data from its initial input through final output. HIHAN will provide the operator with a full view of the data flow process. The system will employ electronic display and storage techniques, software manipulation, statistical evaluation, and human-engineered interfaces.

The HIHAN system will automate the preprocessing, merging, integration, and preparation of hydrographic data from a variety of sources such as the ships, launches, and the Hydrographic Airborne Laser Sounder (HALS). The HIHAN System will be expandable so that it can accommodate new technology developments. The planning and formats established for the integration/merging of the data will prevent incompatible data structures in the future and provide a mechanism for orderly growth and utilization of advanced survey technologies, e.g., side-scan, SEABEAM and other multi-beam sonars, real time contour data analysis, satellite telemetry, and remotely telemetered environmental and position data. HIHAN will produce a magnetic data tape containing all of the information necessary for the generation of hydrographic smooth sheets, including shoreline, depths, geodetic stations, current stations, tide stations, aids to navigation, and hazards to navigation.

HIHAN will include the current and proposed HODAS shipboard system and the developing HYAIS in-house system and will integrate these and other new technical developments into a total information management system with a

hydrographic database, interactive graphics editing and magnetic tape storage and retrieval system. The applications of the HODAS and the HYAIS systems to HIHAN are described below.

1.1 HODAS PROCESSING

HODAS processing includes the integration of data from the following sources:

HODAS RT System - Is the real time system aboard ship that collects the data from the ship's sensors. This data will be recorded on tape for post-processing on the HODAS post-processing computer. The on-board field sheets and the computer generated tape containing the processed data and the ship board reducers will be further processed on the in-house HYAIS System to apply an improved set of survey parameters (i.e., precise navigation controls, observed tide, rather than predicted tide, etc.) and to submit the field data to verification procedures.

BDLS - The Boat Data Logger System will provide the position and sounding data for input to the HODAS System on a cassette tape that can be read into the HODAS post-processing computer on the ship to be combined with the HALS and RTS data to develop the computer tape that will be used as input to the HYAIS System at NSTL.

HALS - The HALS (Hydrographic Airborne Laser Sounder) data will be collected when the helicopter is available and will be recorded on a 9 track cartridge tape that will be processed by the HODAS post-processing computer. The area to be surveyed by the HALS System will be covered with several missions and there will be time available on the HODAS post-processing computers to process the data on-board during the time the ship is in the survey area.

There exists historical data to be used, in addition to the acquired data, in generating the processed field data tape. This historical data includes data collected previously in the same survey area (especially past and current versions of charts depicting the survey area) as well as information regarding both aids and reported hazards to navigation, and local tides and currents within the survey area. The historical data can be digitized (when necessary) in order to construct overlays showing coastlines, aids to navigation, etc. These overlays could be constructed, modified and applied to field sheets at the hydrographer's convenience.

Under HIHAN the HODAS post-time processing of the raw data recorded in real-time on the ship and on the data logging systems aboard the hydrographic soundboats will allow personnel to edit and review the navigation and sounding data as it is displayed on a graphics CRT terminal. This will be more efficient and allow personnel to review more data per unit time, thus increasing productivity. Additional post-time processing will be added to the HODAS system when the HALS system becomes operational.

1.2 HYAIS PROCESSING

The HIHAN in-house processing scheme will be implemented on the HYAIS system and will consist of three modes. The first and primary mode, includes both the continued processing of the data contained on the processed field data tape generated on HODAS, and an edit/verification process to help insure the quality of the smooth sheet. Smooth sheet generation takes place upon the completion of the additional processing and of the edit/verification process.

The second mode is intended to be a back-up mode. The in-house processing scheme is designed along the same lines as the shipboard processing scheme. This parallel design will make it possible to process raw or partially processed data in-house.

The third mode entails the processing of data collected on surveys where HODAS is not available. Examples of such surveys include surveys conducted under contract with private industry, surveys conducted by NAVOCEANO from platforms other than USNS CHAUVENET and USNS HARKNESS, surveys conducted by other governments with United States assistance and surveys conducted by other U.S. government agencies with NAVOCEANO assistance.

Manual surveys that are conducted will also be processed by HIHAN using the HYAIS system to produce the magnetic data tape that contains the smooth sheet information needed by DMA.

The data collected from automated surveys other than HODAS (Autocarta for example) will be processed by HIHAN using the HYAIS system to produce the magnetic data tape that contains the smooth sheet information needed by DMA.

2. DESCRIPTION OF EXISTING SYSTEM

The existing system for reduction and evaluation of sounding data is manually oriented and labor intensive. Further, much of the labor is redundant as many of the functions initially performed aboard ship are reperformed in-house as part of the verification process.

The smooth sheet is the final and most important output generated. The information displayed on the smooth sheet includes hydrographic data from the survey area along with shoreline data and the positions of geodetic stations, current stations, and tide stations as well as the locations of both hazards and aids to navigation.

Other output data elements include Track Sheet, Sounding Sheet, Ocean Track Sheet, Sonar Swath Sheet, miscellaneous documents (Survey Plans, Geodetic Position and Station Descriptions, Tidal Analyses, Revisions to Sailing Directions), and Survey Log Record on Microfilm (smooth track and sounding sheets included).

The existing collection and processing systems are described below.

2.1 EXISTING DATA COLLECTION SYSTEM

The data collected in the field during hydrographic survey operations is recorded in several forms and processed primarily by manual methods. Only three input data elements: the Ship Real-Time System (RTS) tape, Boat Data Logger System (BDLS), and the HALS tapes are produced as a result of automatic data collection devices in a form suitable for direct input to an automatic data processing system. Other input data elements are in the form of analog

traces (Side Scan Sonar Trace, Sawtooth Trace, Echo Sounder Trace, Tide Marigram), field books (Geodetic Field Book, Sounding Journal), field sheets (Track Sheet, Sounding Sheet), and miscellaneous documents (Shoreline Source Data, Shore Manuscript, Current Measurements, Water Clarity, Temperature Readings, Bottom Samples, Descriptive Reports).

Both hydrographic and position data are collected by each of the collection systems (HODAS RTS, BDLS, HALS). The following subsections contain brief descriptions of the devices used to collect position data and hydrographic data.

2.1.1 Position Data Collection

Positioning while in a survey area is generally accomplished using medium or short range equipment. The five commonly used systems are briefly described below.

- ARGO DM 54 - is a multi-user system manufactured by Cubic Western Data Corporation. It is a phase comparison system capable of measuring hundredths of lane and can be used in either range-range or hyperbolic mode. The system operates on a single frequency in the 1.6 to 1.8 MHz band at ranges of up to 400 miles in daylight (200 miles at night) with repeatabilitly of 8-10 meters.

- Raydist DRS - is a multi-user system manufactured by the Hastings Raydist Corporation. This is also a phase comparison system and can be used in either range-range or hyperbolic mode. The system operates on continuous waves in the 1.6 to 4.0 MHz band with a range to 150 miles. Repeatability is approximately ± 3 meters.

- Trisponder - is a multi-user system manufactured by Del Norte Corporation. This is a short range (up to 47 miles) system operating at 9450 MHz. An interrogator/receiver located aboard ship interrogates two fixed shore stations to establish position in the range-range mode.

- Mini-Ranger III - is a short range (up to 47 miles) system manufactured by Motorola Corporation. This is a range-range system utilizing pulse radar techniques. The system's probable accuracy is approximately 10 feet. The interrogator receiver aboard ship transmits on a frequency of 5480 MHz and receives on a freqecny of 5570 MHz.

- Autotape - is a short range system manufactured by Cubic Western Data Corporation. This is a range-range system operating in the 2.9 to 3.1 GHz range. The signal is modulated by a 1500, 150 or 15 KHz carrier frequency.

Positioning outside of a survey area is performed only by the mother ship using long range equipment. The following systems are commonly used and their data is recorded on the HODAS RTS tape.

- MX-706 Satellite Navigator - is a passive system manufactured by Magnavox. The receiver/computer is a self-contained system capable of receiving satellite data throughout the satellite pass (approximately 20 min.), integrating DR estimates of speed and course made good, and calculating geographic position. The frequency of these fixes varies with the user's latitude from approximately every 30 minutes to several

hours. For a more detailed discussion of the Satellite Navigation System see "The Transit Navigation Satellite System - Status, Theory, Performance, Applications", by T. A. Stansell published by Magnavox, Oct. 1978.

- LORAN-C - is a passive, long-range, time difference system. Various brands of units are used to measure the time difference between the reception of pulses received from one master and any of several slave stations. These time differences are recorded directly on the HODAS RTS tape. For more information on LORAN-C see "Dutton's Navigation and Plotting, 13th Edition, by E. S. Maloney, Naval Inst. Press, 1978 or "American Practical Navigator - An Epitome of Navigation - 1977 Edition", originally by N. Bowditch, published by DMAHC, 1977.

2.1.2 Hydrographic Data Collection

Hydrographic data is collected using both deep- and shallow-water echo sounders. The three commonly used systems are described below.

- Raytheon DSF-600 - is a shallow water echo sounder. It is used to measure depths from 0-600 fathoms.

- Harris Narrow Beam Echo Sounder - is a deep water echo sounder. It is used to measure depths ranging from 24 to 6,000 fathoms.

- Wide Beam Echo Sounder - is a wide beam, deep water echo sounder manufactured by Raytheon. It is used to measure depths ranging from 24 to 6,000 fathoms.

3.0 PROPOSED SYSTEM FEATURES

The proposed system will be patterned after the existing system in that it will automate some of the existing functions to streamline the production of smooth sheets. The interactive graphics editing capability to be built into HIHAN, will serve to streamline both editing and verification procedures. To be of maximum value, the development of this capability will require that the hydrographic data files (for a given accession) be configured as a database.

In order to streamlin the retrieval of archived data, and to provide a mechanism to identify the status of a current data set, a Hydrographic Library will be included in HIHAN.

Each of the features is further described below.

3.1 DEVELOPMENT OF INTERACTIVE GRAPHICS EDITING

Interactive Graphics Editing (IGE) will serve to substantially reduce the number of reconstructed overlays and smooth sheets by permiting the hydrographer to view graphic representations of overlays and smooth sheets (on a CRT) prior to generating hard copies. This capability will enable the hydrographer to identify and correct many of the errors prior to generation of mylar overlays and smooth sheets.

Shipboard IGE will be limited by the capabilities of the HODAS hardware to include only black and white capability. Color IGE is both desirable and practical in-house. Both in-house and shipboard IGE will provide the following capabilities:

- View data in several formats.
- Manipulate blocks of data.
- Implement changes to data files without the need to reconstruct overlays or smooth sheets.
- Contouring.

In addition, the in-house IGE will enable the hydrographer to construct and modify overlays independent of, or in conjunction with, other overlays.

3.2 DATABASE CONFIGURATION

It is always desirable to minimize computer response time when developing interactive editing capabilities. The most practical means to this end, in this case, is to treat the set of data files associated with a given smooth sheet as a database. This will require the generation of index and cross-index files in order to lessen the time needed to access data elements.

3.3 DEVELOPMENT OF A HYDROGRAPHIC LIBRARY

The establishment of a Hydrographic Library will greatly increase the accessibility of archived data. The library will contain the following three types of data:

- Management Information Data
- Accession Data
- Hydrographic Data

Each data type is describe below.

It should be noted that the establishment of the library is necessary to maximize the value of the graphics editor.

3.3.1 Management Information Files

Management Information Files will be generated at sea and in-house. Both files will contain the same types of information and will serve the same purposes. The specific data in the files will differ somewhat to reflect the unique requirements of each system. Upon delivery of the field data in-house, any shipboard management information data pertinent to in-house processing will be included in the in-house MIF.

Management information will include data on the following:

- Processing status
- Users involved in processing
- Proposed changes
- Plot scales and biases.

In order to enhance the "correctness" of the edited data, the data will be reviewed by another user after editing. The changes proposed by the first editor will have to be verified by the second in order to be implemented.

Maintaining this Management Information Data File serves two basic purposes. The first is to provide a means to immediately identify the status of a data set. The second is to provide a means to "back step" through the processing of a data set. This will simplify the defense of the quality of processed data.

3.3.2 Accession Data Files

Accession Files will be maintained both aboard ship and in-house. Both files will contain the same type of data and will serve similar purposes.

Accession data will include, for each survey completed, information on the following:

- Survey identification
- Survey coverage area
- Resolution of data
- Quality of data
- Location and status of the data.

The Accession Files will contain pointers into the Hydrographic Data Libraries aboard ship or in-house enabling the hydrographer to quickly locate and access hydrographic data. It will be possible, for example, using the In-House Accession Data in conjunction with the in-house color graphics capability to

generate charts showing data coverage areas in a matter of minutes. These charts could be produced on either a world wide or a local scale and could show only surveys with a specified common attribute (surveys conducted after a certain date, for example).

3.3.3 Hydrographic Data Libraries

Hydrographic Data Libraries will be maintained both aboard ship and in-house. Both libraries will contain the same types of data and will serve the same purposes. The Shipboard Library will contain all of the data collected during the current survey (or the data collected in the survey area, if necessary) while the In-House Library will contain all archived data from past surveys.

Hydrographic data includes depth and position data in both the raw and processed forms. This data will be stored on magnetic tape (unless it is currently being processed). Pointers in the Accession Data Files will indicate tape numbers of primary and backup copies of both the raw and the processed data. Pointers will also indicate the locations of the original analog data traces. The use of these pointers will permit quick and efficient access to archived data.

4.0 PROPOSED SYSTEM - LOGICAL DESIGN

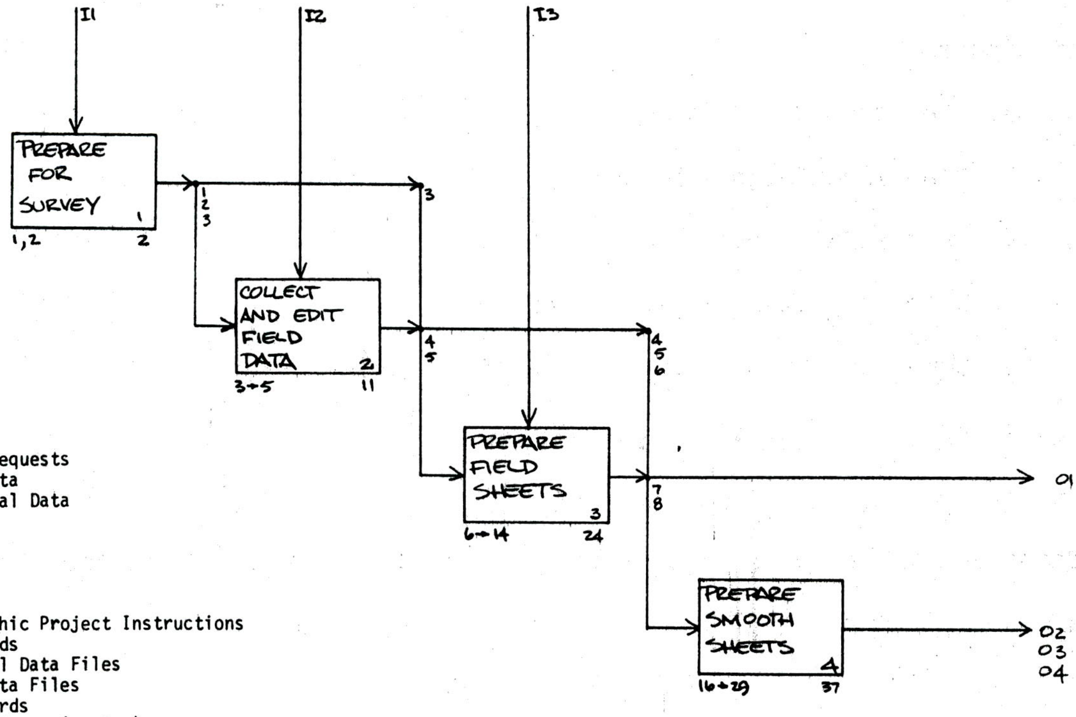
The HIHAN system will serve to automate survey preparation, data collection and editing, field sheet preparation, and smooth sheet preparation. The following set of data flow diagrams (DFDs) describes each of these functions in detail indicating which processes are to be automated and which are to remain manual. These diagrams employ Structured Analysis techniques (see Appendix 1 for brief description of both the philosophy and the format of Structured Analysis DFDs). This logical design is based on the Scenario included as Appendix 5.

It is important to realize that this set of diagrams depicts the logical, or functional, design of the HIHAN system. The purpose of the logical design is to identify the specific functions to be included in the system. It is not intended to address the means of implementation. Specification of the means of implementation is in the domain of a physical, or program design. In other words, the logical design answers the question: what is to be done? The physical design answers the question; how is it to be done?

NODE : Ø

NUMBER: 1

HIHAN DATA FLOW



Input:
- I1 - Survey Requests
- I2 - Field Data
- I3 - Historical Data

Intermediate:
- 1 - Hydrographic Project Instructions
- 2 - Survey Aids
- 3 - Historical Data Files
- 4 - Edited Data Files
- 5 - Tide Records
- 6 - Raw Data Tapes (copies)
- 7 - Field Sheet
- 8 - Field Sheet File

Output:
- 01 - Field Sheet
- 02 - Updated Geodetic Data Base
- 03 - Smooth Sheet File
- 04 - Signed Smooth Sheet

4.1 SURVEY PREPARATION

Survey preparation is broken into the following six separate functions as shown in diagram 2.

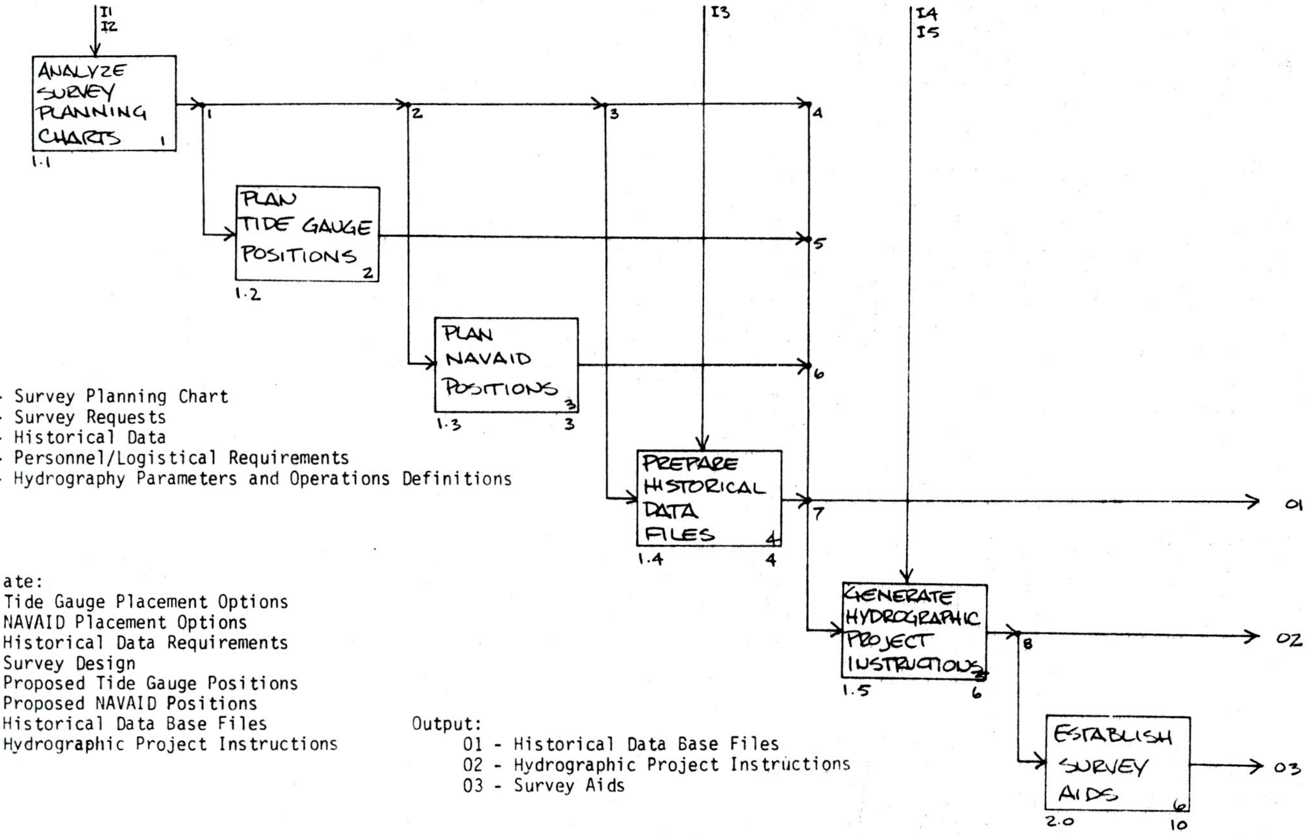
- Analyze Survey Planning Charts
- Plan Tide Gauge Positions
- Plan NAVAID Positions
- Prepare Historial Data Files
- Generate Hydrographic Project Instructions
- Establish Survey Aids

These functions correspond to tasks 1 and 2 of the Scenario (see Appendix 5) and are further described in diagrams 3 through 10.

NODE: 1

NUMBER: 2

PREPARE FOR SURVEY



Input:

- I1 - Survey Planning Chart
- I2 - Survey Requests
- I3 - Historical Data
- I4 - Personnel/Logistical Requirements
- I5 - Hydrography Parameters and Operations Definitions

Intermediate:

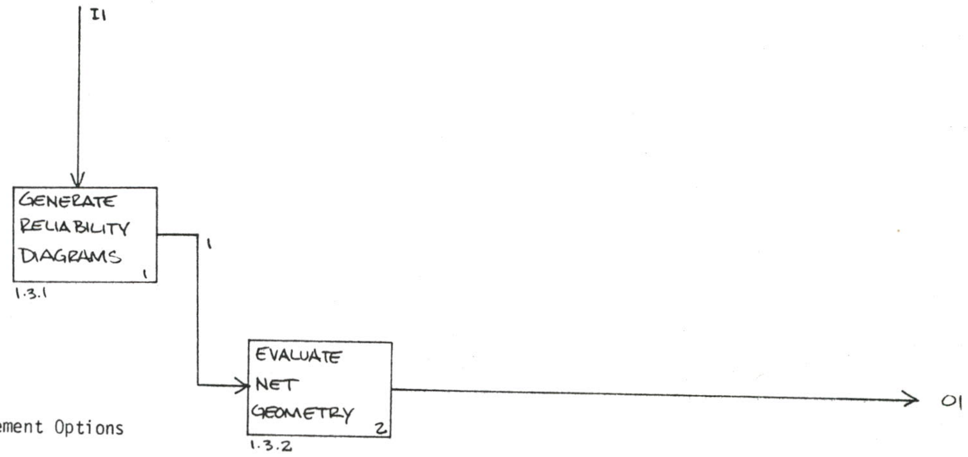
- 1 - Tide Gauge Placement Options
- 2 - NAVAID Placement Options
- 3 - Historical Data Requirements
- 4 - Survey Design
- 5 - Proposed Tide Gauge Positions
- 6 - Proposed NAVAID Positions
- 7 - Historical Data Base Files
- 8 - Hydrographic Project Instructions

Output:

- 01 - Historical Data Base Files
- 02 - Hydrographic Project Instructions
- 03 - Survey Aids

NODE: 1.3
NUMBER: 3

PLAN NAVAID POSITIONS



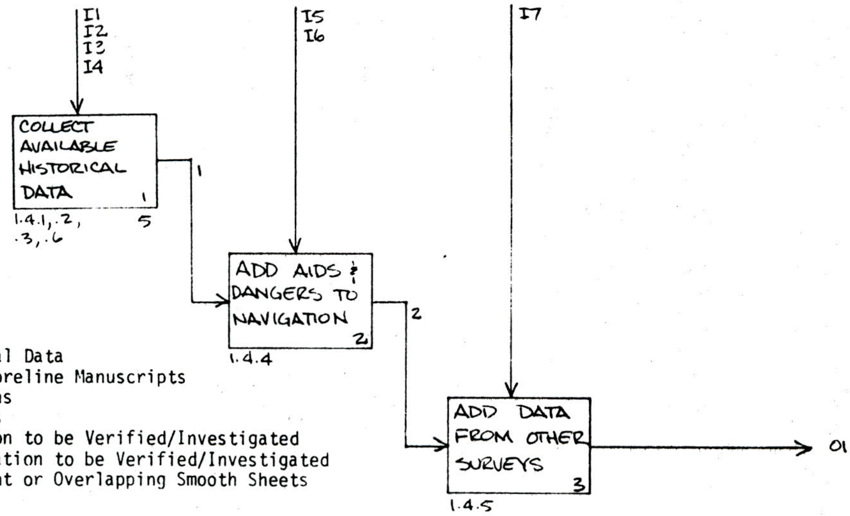
Input:
I1 - NAVAID Placement Options

Intermediate:
1 - Reliability Diagrams

Output:
O1 - Proposed NAVAID Positions

NODE: 1.4
NUMBER: 4

PREPARE HISTORICAL DATA FILES



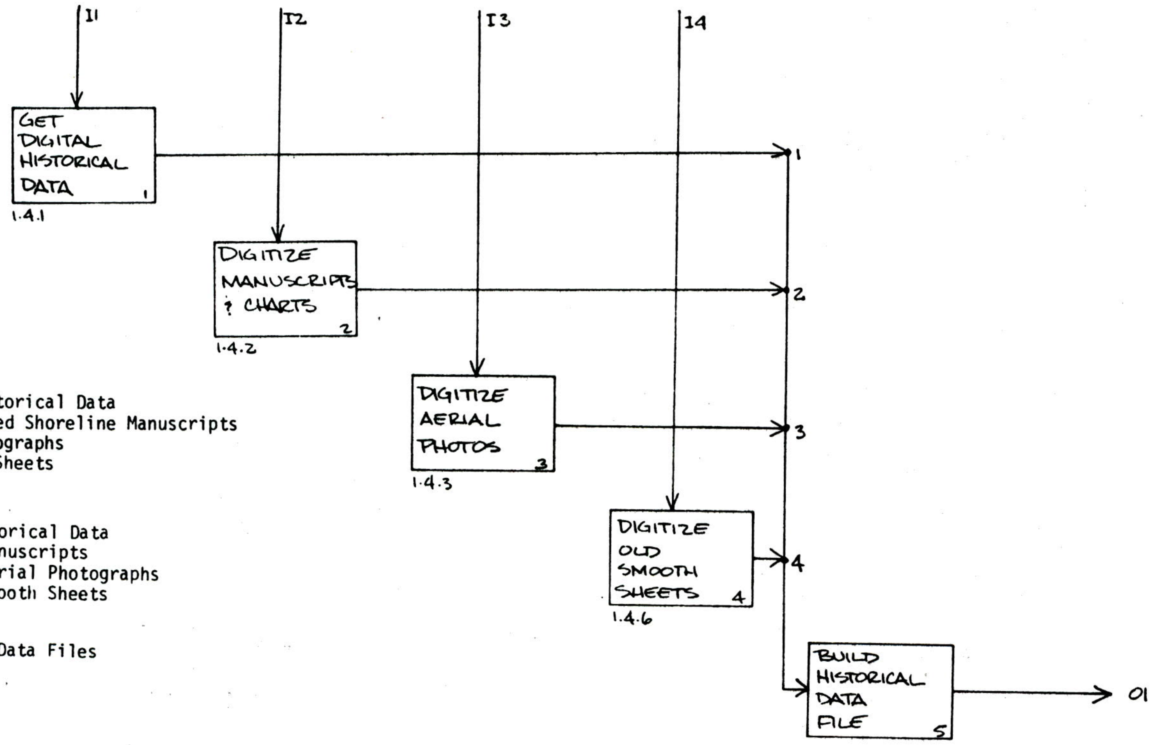
Input:
- I1 - Digital Historical Data
- I2 - DMA Furnished Shoreline Manuscripts
- I3 - Aerial Photographs
- I4 - Old Smooth Sheets
- I5 - Aids to Navigaiton to be Verified/Investigated
- I6 - Dangers to Navigation to be Verified/Investigated
- I7 - Data From Adjacent or Overlapping Smooth Sheets

Intermediate:
- 1 - Historical Data Files
- 2 - Historical Data and Aids/Dangers to Navigation

Output:
- O1 - Historical Data Base Files

NODE: 1.4.1
NUMBER: 5

COLLECT AVAILABLE HISTORICAL DATA



Inputs:
- I1 - Digital Historical Data
- I2 - DMA Furnished Shoreline Manuscripts
- I3 - Aerial Photographs
- I4 - Old Smooth Sheets

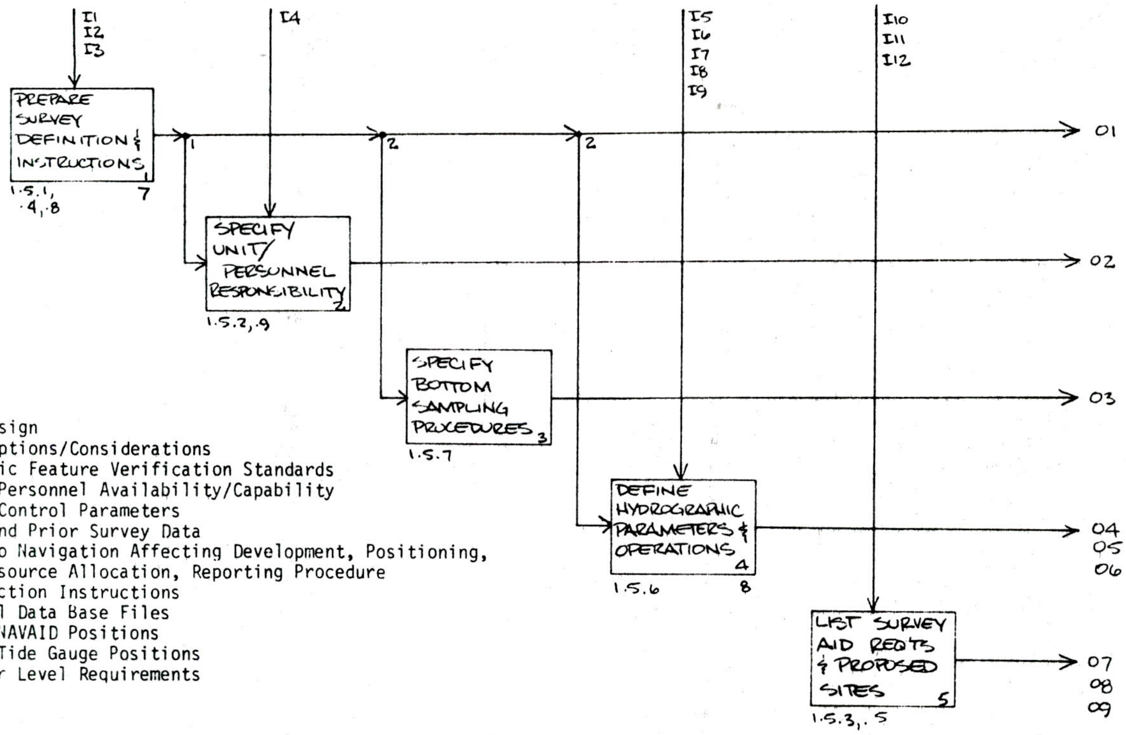
Intermediate
- 1 - Digital Historical Data
- 2 - Digitized Manuscripts
- 3 - Digitized Aerial Photographs
- 4 - Digitized Smooth Sheets

Output:
- O1 - Historical Data Files

NODE: 1.5

NUMBER: 6

GENERATE HYDROGRAPHIC PROJECT INSTRUCTIONS



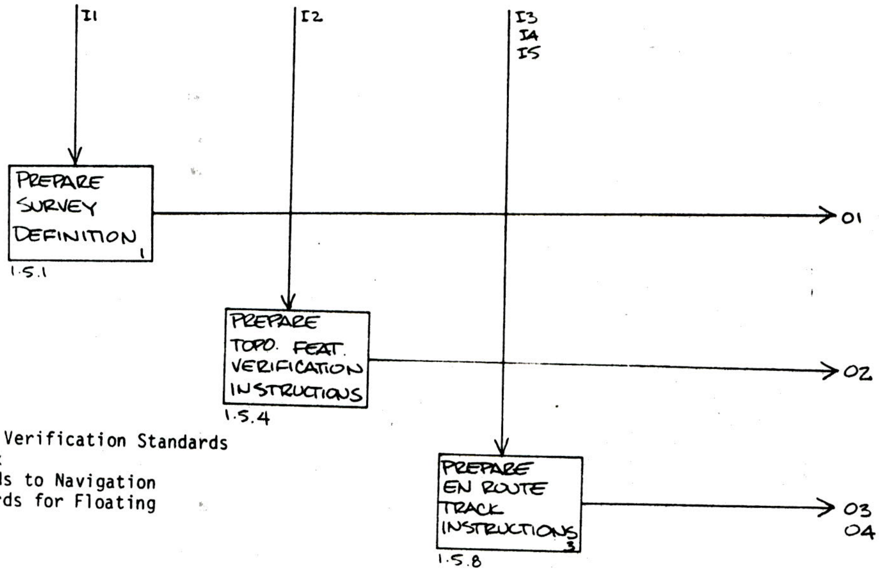
Input:
- I1 - Survey Design
- I2 - Routing Options/Considerations
- I3 - Topographic Feature Verification Standards
- I4 - Unit and Personnel Availability/Capability
- I5 - Position Control Parameters
- I6 - Landsat and Prior Survey Data
- I7 - Dangers to Navigation Affecting Development, Positioning, Survey Resource Allocation, Reporting Procedure
- I8 - Data Reduction Instructions
- I9 - Historical Data Base Files
- I10 - Proposed NAVAID Positions
- I11 - Proposed Tide Gauge Positions
- I12 - Tide/Water Level Requirements

Intermediate:
- 1 - Survey Resource Requirements
- 2 - Survey Quality and Scope

Outputs:
- 01 - Survey Definitions and Instructions
- 02 - Unit & Personnel Assignments and Responsibilities
- 03 - Bottom Sampling Procedures
- 04 - Position Control Techniques
- 05 - Resurvey Items
- 06 - Instructions on Dangers to Navigation Affecting Development, Positioning, Resource Allocation, Reporting Procedures
- 07 - List of Proposed NAVAID Positions
- 08 - List of Proposed Tide Gauge Positions
- 09 - Survey Aid Positioning Requirements.

NODE: 1.5.1
NUMBER: 7

PREPARE SURVEY DEFINITION & INSTRUCTIONS



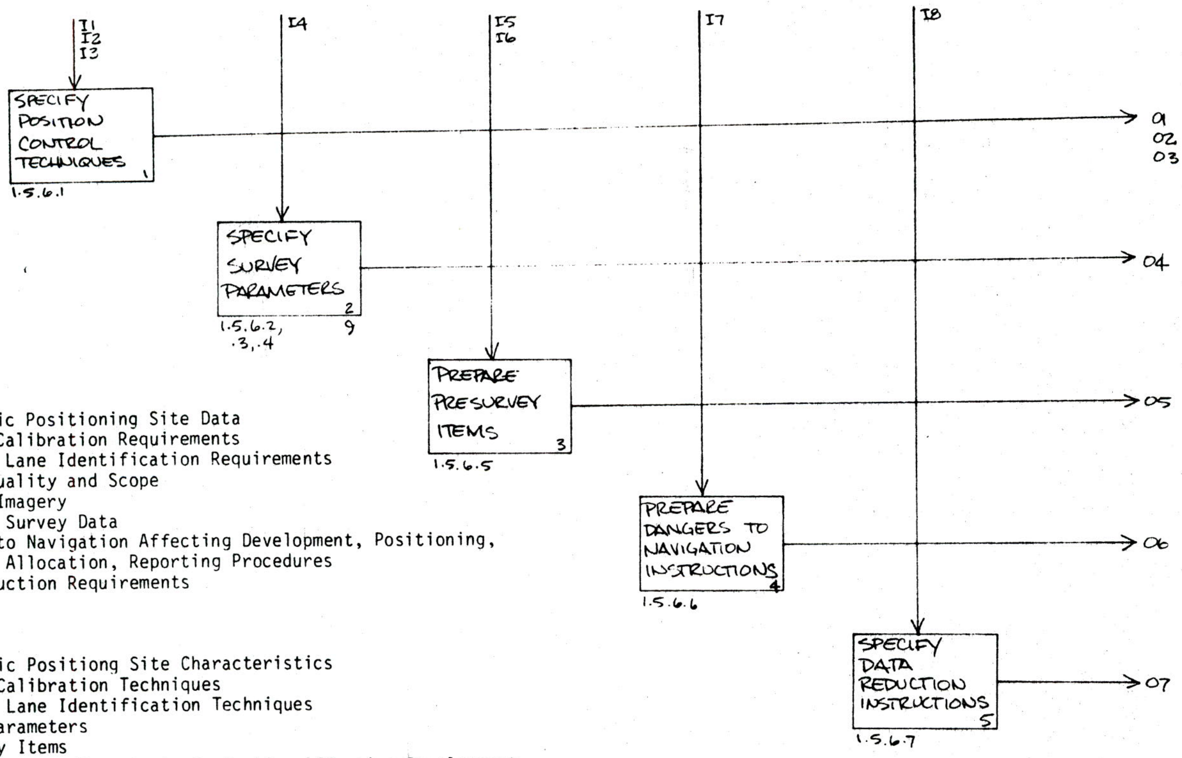
Input:

I1 - Survey Design
I2 - Topographic Feature Verification Standards
I3 - En-route Ocean Track
I4 - List of Floating Aids to Navigation
I5 - Verification Standards for Floating Aids to Navigation

Output:

01 - Specification of Survey, Purpose, Location, Time, Security, Affected Charts, Scope and Quality
02 - Specific Instructions Regarding Verification of Topographic Features
03 - Instructions for En-route Ocean Track
04 - Specific Instructions for Verification of Floating Aids to Navigation.

NODE: 1.5.4 | DEFINE HYDROGRAPHIC PARAMETERS & OPERATIONS
NUMBER: 8



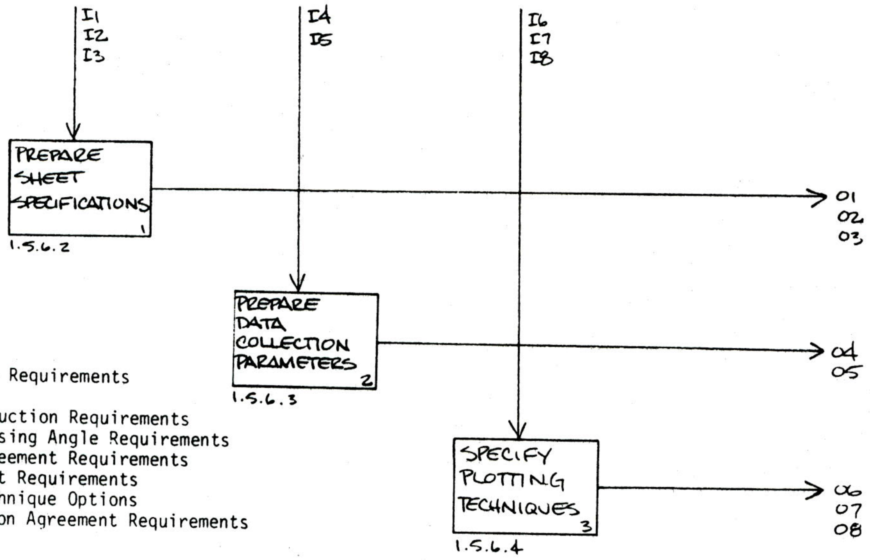
Inputs:
- I1 - Electronic Positioning Site Data
- I2 - Station Calibration Requirements
- I3 - Periodic Lane Identification Requirements
- I4 - Survey Quality and Scope
- I5 - Landsat Imagery
- I6 - Previous Survey Data
- I7 - Dangers to Navigation Affecting Development, Positioning, Resource Allocation, Reporting Procedures
- I8 - Data Reduction Requirements

Output:
- 01 - Electronic Positiong Site Characteristics
- 02 - Station Calibration Techniques
- 03 - Periodic Lane Identification Techniques
- 04 - Survey Parameters
- 05 - Presurvey Items
- 06 - Instructions on Dangers to Navigation Affecting Development, Positioning, Resource Allocation, Reporting Procedures
- 07 - Data Reduction Instructions

NODE: 1.5.4.2

NUMBER: 9

SPECIFY SURVEY PARAMETERS



Input:

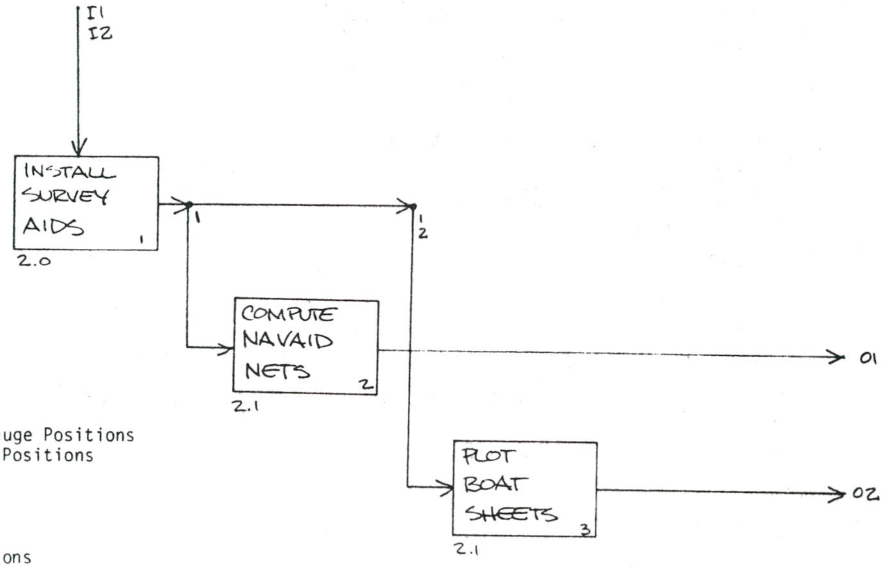
- I1 - Survey Scale Requirements
- I2 - Survey Area
- I3 - Sheet Construction Requirements
- I4 - Spacing/Crossing Angle Requirements
- I5 - Sounding Agreement Requirements
- I6 - Sounding Unit Requirements
- I7 - Plotting Technique Options
- I8 - Sheet Junction Agreement Requirements

Output:

- 01 - Survey Scales
- 02 - Survey Area
- 03 - Sheet Construction Specifications
- 04 - Spacing/Crossing Angle Specifications
- 05 - Sounding Agreement Specifications
- 06 - Sounding Unit Definition
- 07 - Plotting Specifications
- 08 - Sheet Junction Agreement Specifications

NODE: 1.6
NUMBER: 10

ESTABLISH SURVEY AIDS



Input:
- I1 - Proposed Tide Gauge Positions
- I2 - Proposed NAVAID Positions

Intermediate:
- 1 - Tide Gauge Positions
- 2 - NAVAID Positions

Output:
- 01 - NAVAID Nets
- 02 - Boat Sheets

4.2 DATA COLLECTION AND EDITING

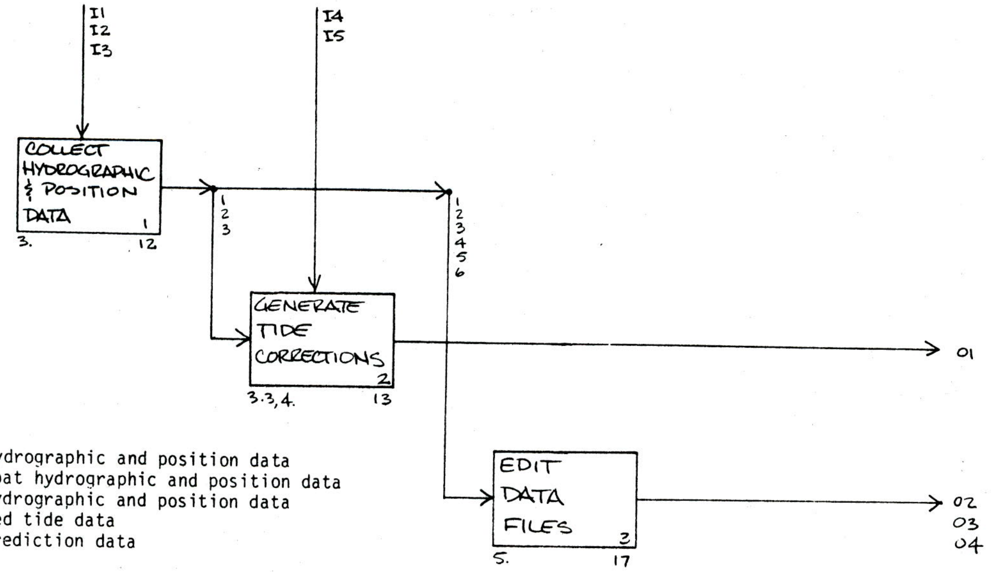
Data collection and editing is broken into the following three functions as shown in diagram 11.

- Collect Hydrographic and Position Data
- Generate Tide Corrections
- Edit Data Files

These functions correspond to tasks 3, 4 and 5 of the Scenario (see Appendix 5) and are further described in diagrams 12 through 23.

NODE: 2
NUMBER: 11

COLLECT AND EDIT DATA



Input:
- I1 - Ship hydrographic and position data
- I2 - Soundboat hydrographic and position data
- I3 - HALS hydrographic and position data
- I4 - Observed tide data
- I5 - Tide prediction data

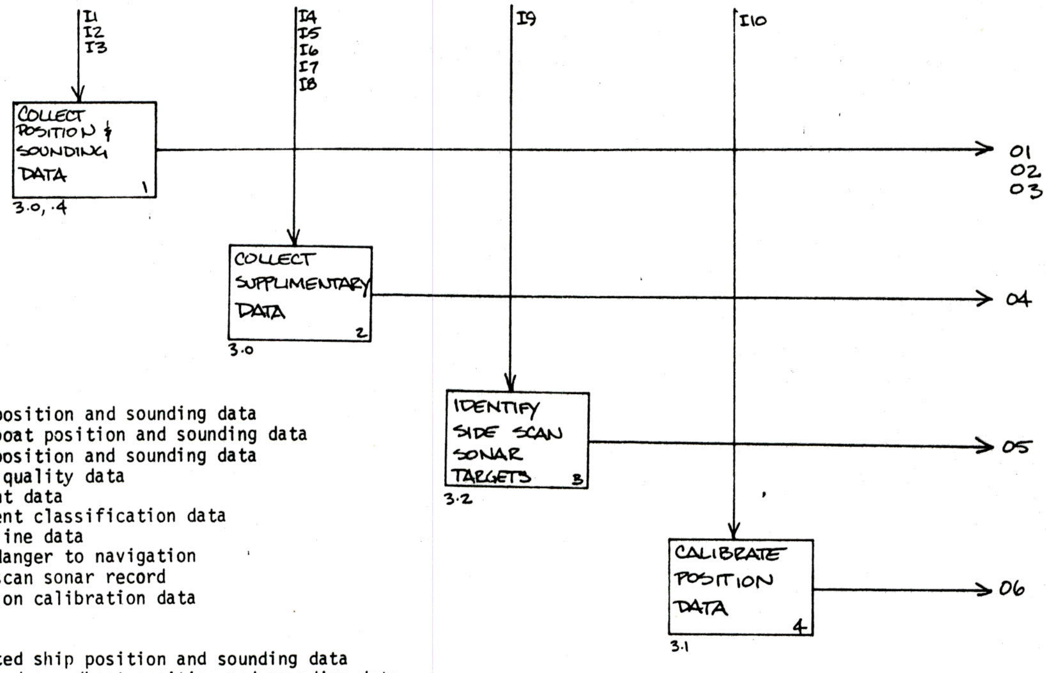
Intermediate:
- 1 - Ship position data
- 2 - Soundboat position data
- 3 - HALS position data
- 4 - Ship sounding data
- 5 - Soundboat sounding data
- 6 - HALS sounding data

Output:
- 01 - Tide file
- 02 - Edited ship position and sounding files
- 03 - Edited soundboat position and sounding files
- 04 - Edited HALS position and sounding files

NODE: 2.1

NUMBER: 12

COLLECT HYDROGRAPHIC & POSITION DATA



Input:

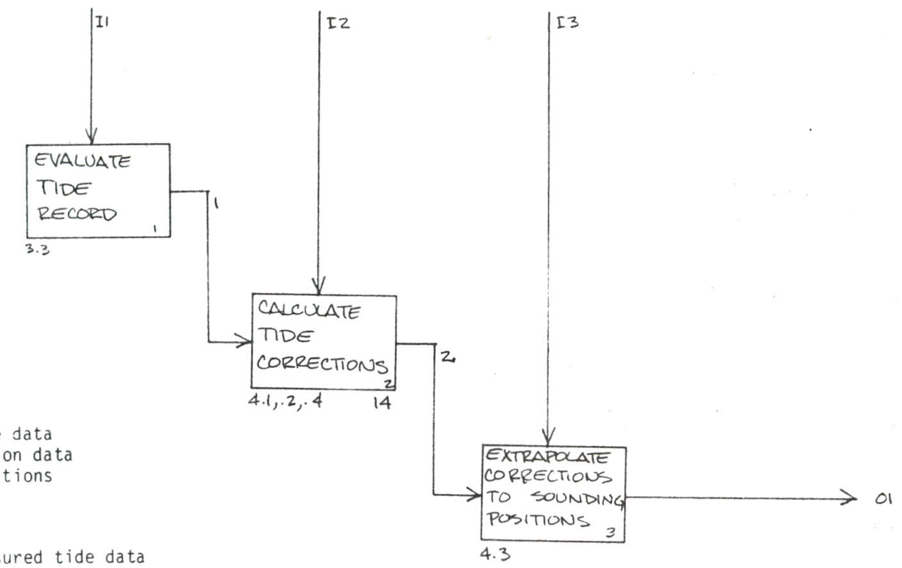
- I1 - Ship position and sounding data
- I2 - Soundboat position and sounding data
- I3 - HALS position and sounding data
- I4 - Water quality data
- I5 - Current data
- I6 - Sediment classification data
- I7 - Shoreline data
- I8 - Aids/danger to navigation
- I9 - Side scan sonar record
- I10 - Position calibration data

Output:

- 01 - Evaluated ship position and sounding data
- 02 - Evaluated soundboat position and sounding data
- 03 - Evaluated HALS position and sounding data
- 04 - Supplimentary data
- 05 - List of side scan targets
- 06 - Position adjustments

NODE: 2.2
NUMBER: 13

GENERATE TIDE FILE



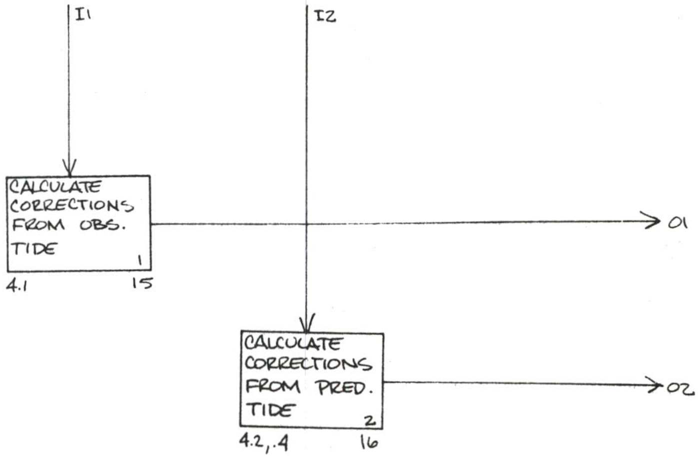
Input:
- I1 - Measured tide data
- I2 - Tide prediction data
- I3 - Sounding positions

Intermediate:
- 1 - Evaluated measured tide data
- 2 - Area-wide tide corrections

Output:
- 01 - Tide file

NODE: 2.2.2
NUMBER: 14

CALCULATE TIDE CORRECTIONS

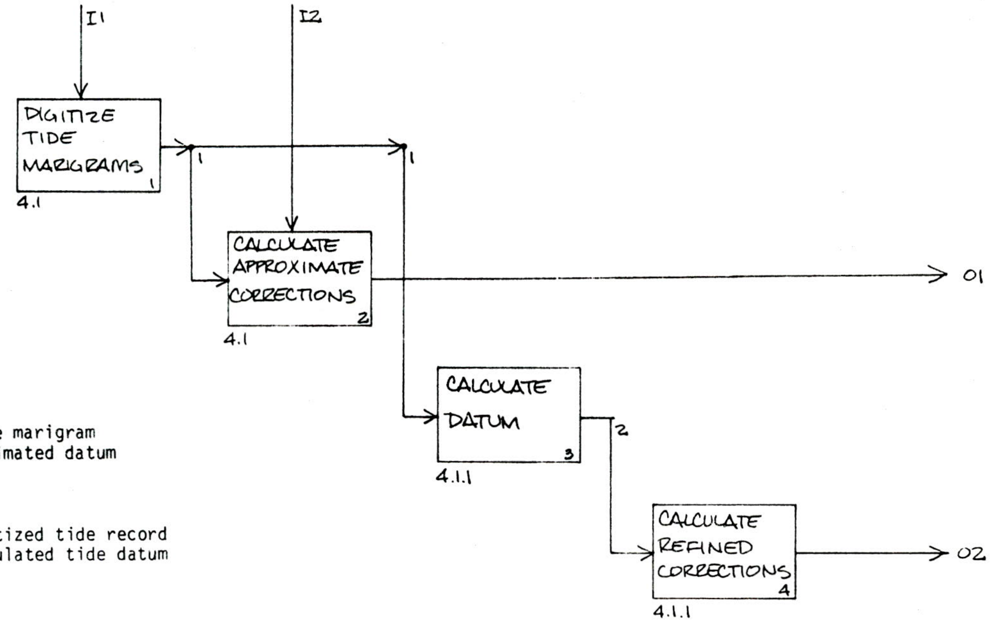


Input:
- I1 - Evaluated tide record
- I2 - Tide prediction data

Output:
- O1 - Observed area-wide tide corrections
- O2 - Predicted area-wide tide corrections

NODE: 2.2.2.1 | CALCULATE CORRECTIONS FROM OBSERVED TIDE

NUMBER: 15



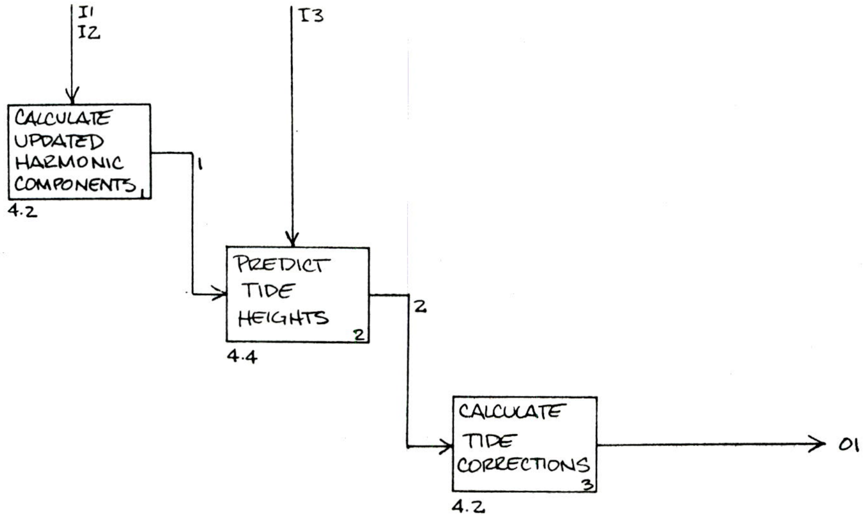
Input:
- I1 - Tide marigram
- I2 - Estimated datum

Intermediate:
- 1 - Digitized tide record
- 2 - Calculated tide datum

Output:
- O1 - Approximate area-wide tide corrections
- O2 - Refined area-wide tide corrections

NODE: 2.2.2.2
NUMBER: 16

CALCULATE CORRECTIONS FROM PREDICTED TIDE



Input:
- I1 - Harmonic constants and astronomical arguments
- I2 - Continuous remote tide gauge measurements
- I3 - Tide differences and height ratios

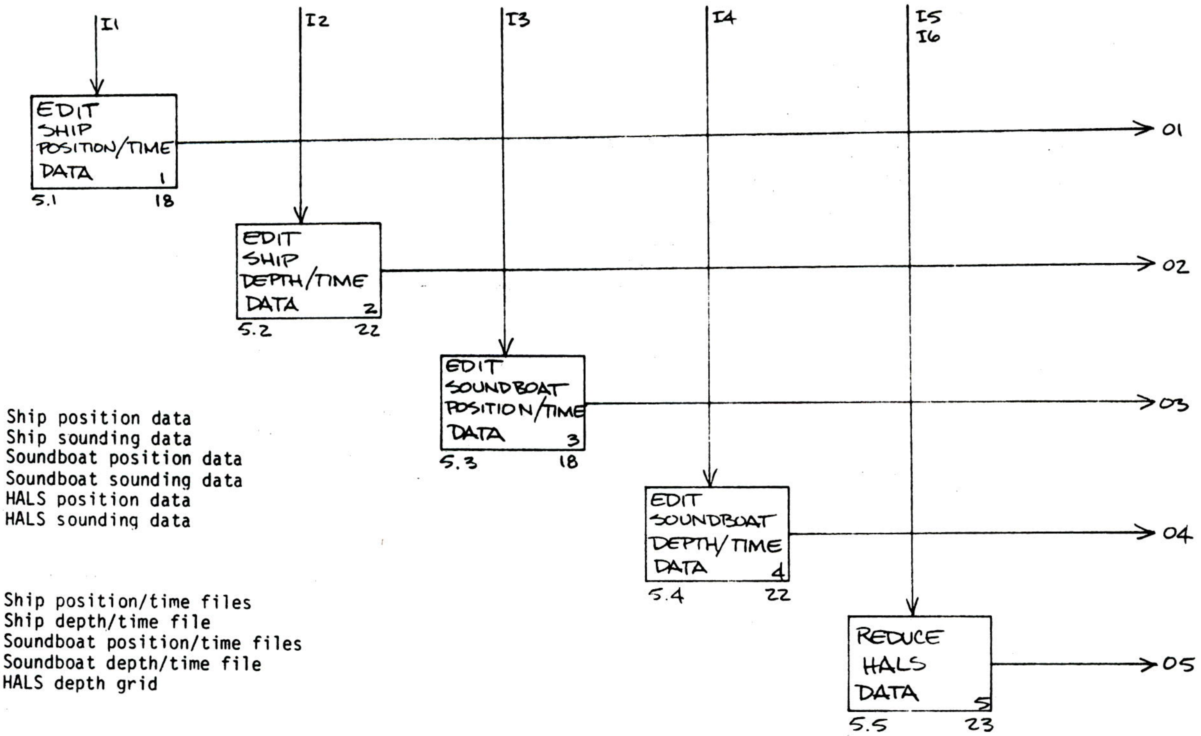
Intermediate:
- 1 - Updated harmonic components
- 2 - Predicted tide heights

Output:

- O1 - Predicted area-wide tide corrections

NODE: 2.3
NUMBER: 17

EDIT DATA FILES

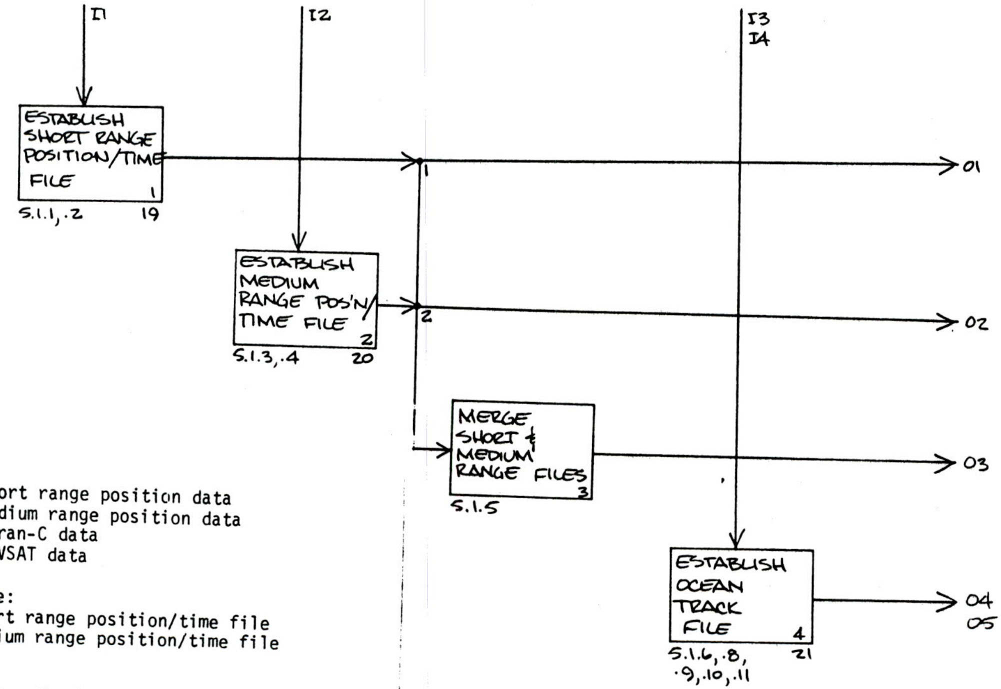


Input:
- I1 - Ship position data
- I2 - Ship sounding data
- I3 - Soundboat position data
- I4 - Soundboat sounding data
- I5 - HALS position data
- I6 - HALS sounding data

Output:
- 01 - Ship position/time files
- 02 - Ship depth/time file
- 03 - Soundboat position/time files
- 04 - Soundboat depth/time file
- 05 - HALS depth grid

NODES: 2.3.1
2.3.3
NUMBER: 18

EDIT POSITION/TIME DATA



Input:
- I1 - Short range position data
- I2 - Medium range position data
- I3 - Loran-C data
- I4 - NAVSAT data

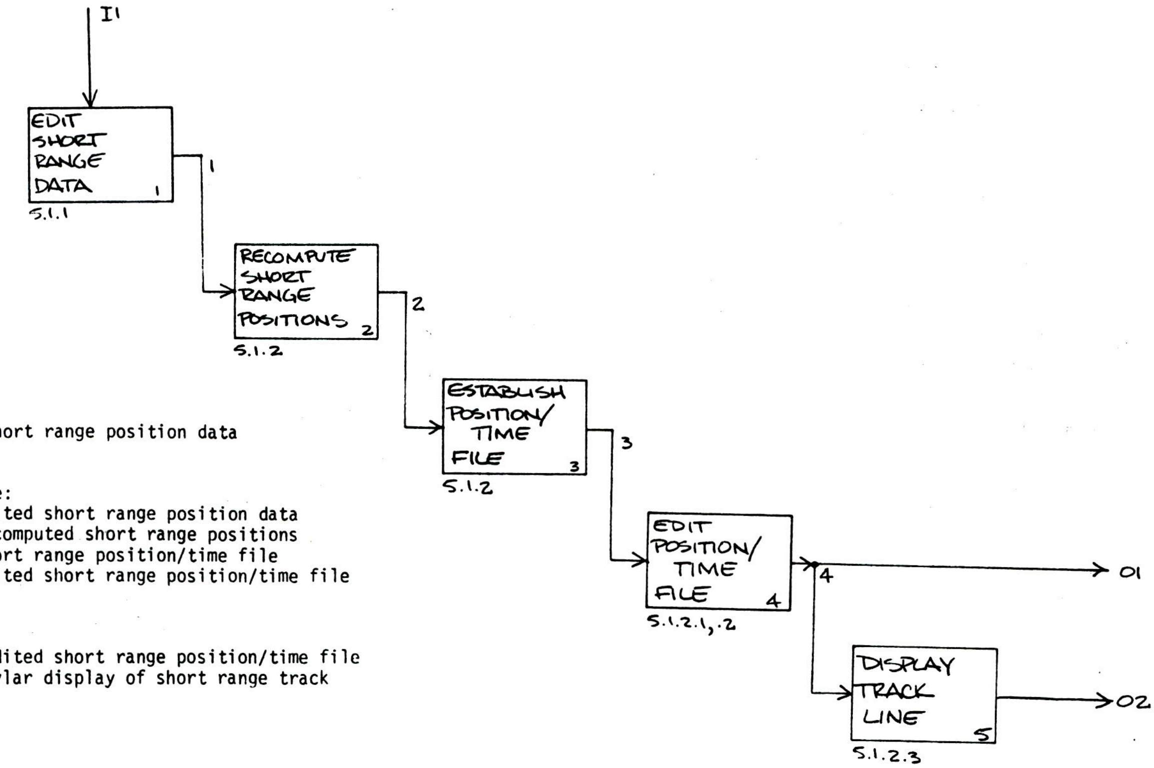
Intermediate:
- 1 - Short range position/time file
- 2 - Medium range position/time file

Output:
- 01 - Mylar display of short range track line
- 02 - Mylar display of medium range track line
- 03 - Short/medium range position/time file
- 04 - Ocean track file
- 05 - Mylar display of ocean track line

NODES: 2.3.1.1
2.3.3.1

NUMBER: 19

ESTABLISH SHORT RANGE POSITION/TIME FILE



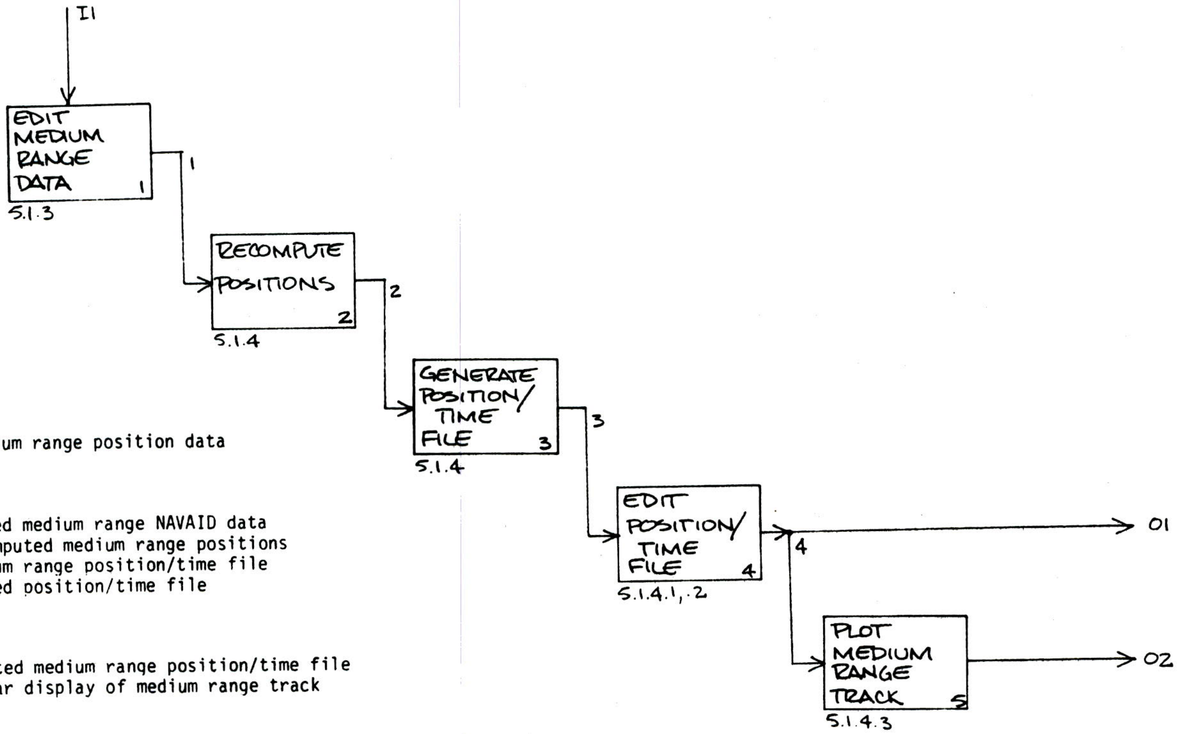
Input:
I1 - Short range position data

Intermediate:
1 - Edited short range position data
2 - Recomputed short range positions
3 - Short range position/time file
4 - Edited short range position/time file

Output:
01 - Edited short range position/time file
02 - Mylar display of short range track

NODES: 2.3.1.2
2.3.3.2
NUMBER: 20

ESTABLISH MEDIUM RANGE POSITION/TIME FILE



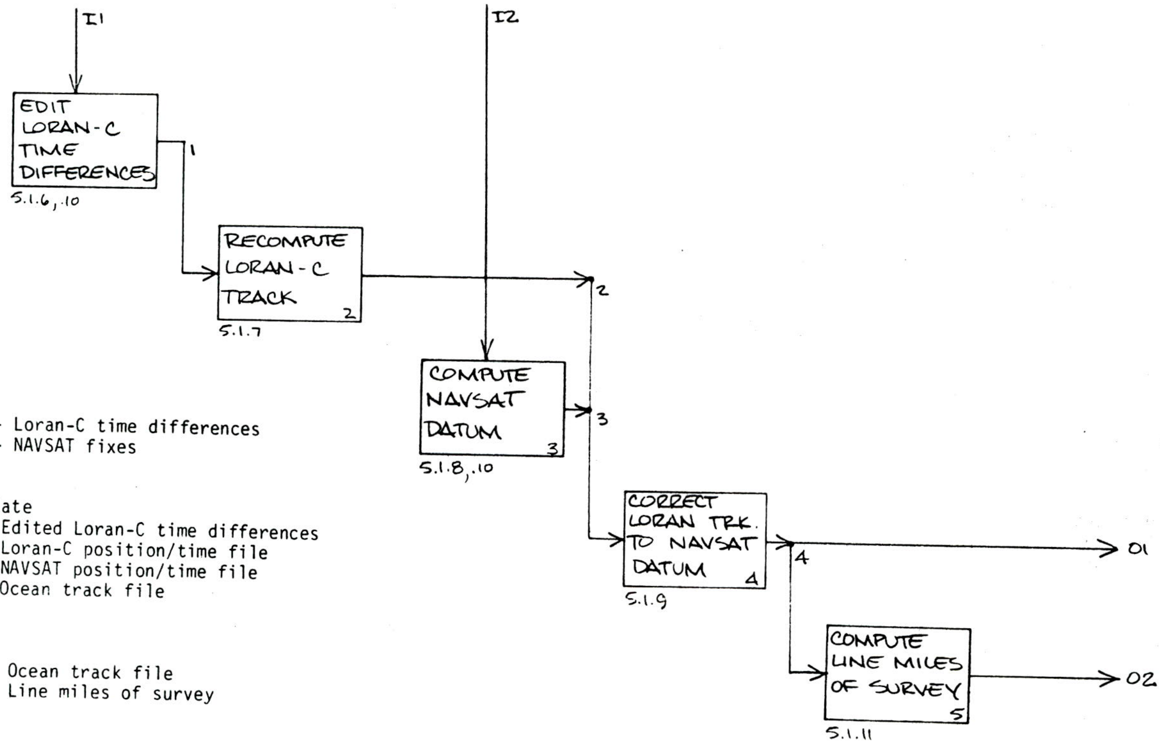
Input:
- I1 - Medium range position data

Intermediate:
- 1 - Edited medium range NAVAID data
- 2 - Recomputed medium range positions
- 3 - Medium range position/time file
- 4 - Edited position/time file

Output:
- 01 - Edited medium range position/time file
- 02 - Mylar display of medium range track

NODE: 2.3.1.4
NUMBER: 21

ESTABLISH OCEAN TRACK FILE



Input:
- I1 - Loran-C time differences
- I2 - NAVSAT fixes

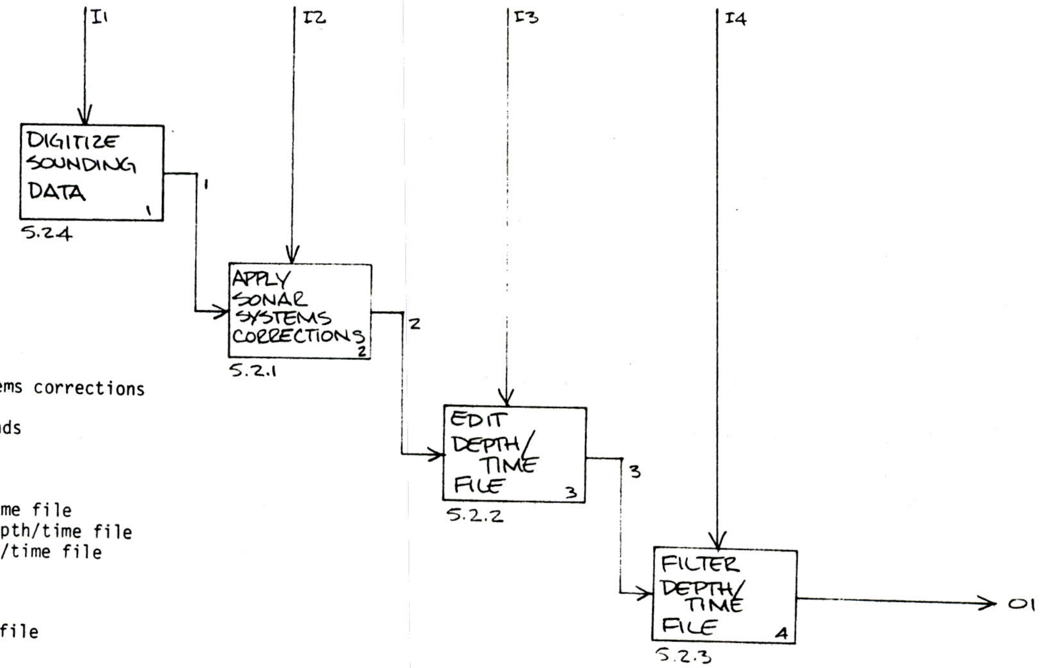
Intermediate
- 1 - Edited Loran-C time differences
- 2 - Loran-C position/time file
- 3 - NAVSAT position/time file
- 4 - Ocean track file

Output:
- O1 - Ocean track file
- O2 - Line miles of survey

NODES: 2.3.2 2.3.4

NUMBER: 22

EDIT DEPTH/TIME DATA



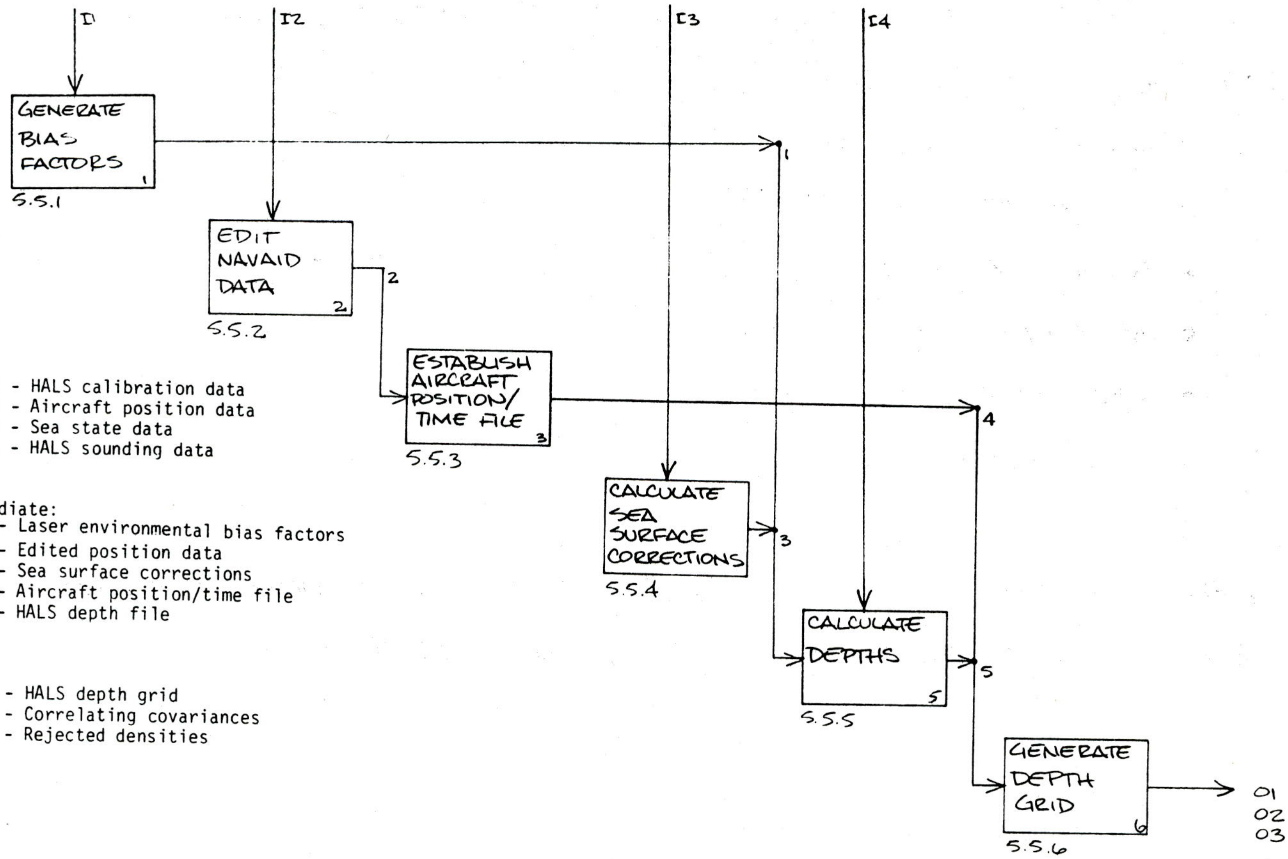
Input:
- I1 - Echograms
- I2 - Sonar systems corrections
- I3 - Sonargrams
- I4 - Filter bounds

Intermediate:
- 1 - Raw depth/time file
- 2 - Corrected depth/time file
- 3 - Edited depth/time file

Output:
- O1 - Depth/time file

NODE: 2.3.5
NUMBER: 23

REDUCE HALS DATA



Input:
- I1 - HALS calibration data
- I2 - Aircraft position data
- I3 - Sea state data
- I4 - HALS sounding data

Intermediate:
- 1 - Laser environmental bias factors
- 2 - Edited position data
- 3 - Sea surface corrections
- 4 - Aircraft position/time file
- 5 - HALS depth file

Output:
- 01 - HALS depth grid
- 02 - Correlating covariances
- 03 - Rejected densities

4.3 FIELD SHEET PREPARATION

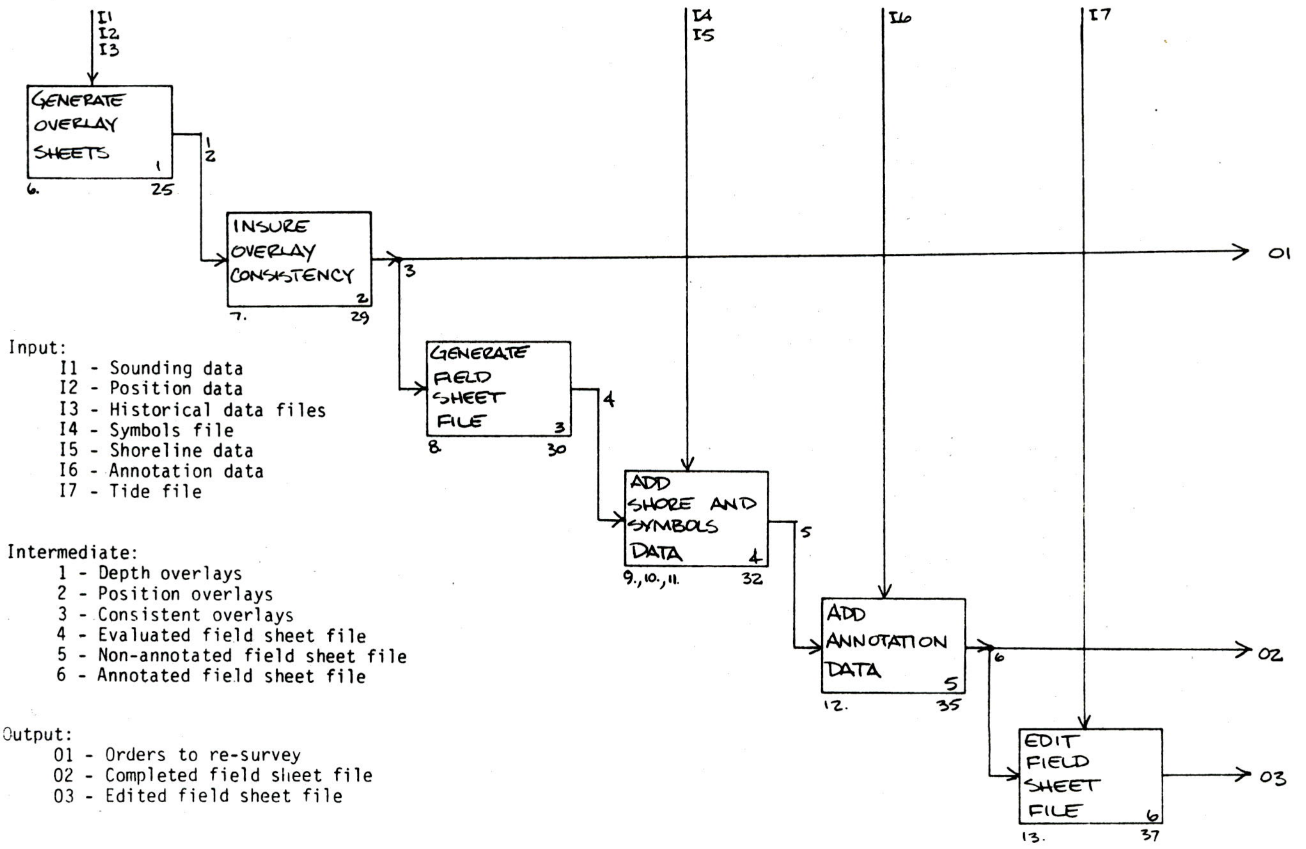
Field sheet preparation is broken into the following six functions as shown in diagram 24.

- Generate Overlay Sheet
- Insure Overlay Consistency
- Generate Field Sheet File
- Add Shore and Symbols Data
- Add Annotation Data
- Edit Field Sheet File

These functions correspond to tasks 6 through 13 of the Scenario (see Appendix 5) and are further described in diagrams 25 through 36.

NODE: 3
NUMBER: 24

PREPARE FIELD SHEETS



Input:
- I1 - Sounding data
- I2 - Position data
- I3 - Historical data files
- I4 - Symbols file
- I5 - Shoreline data
- I6 - Annotation data
- I7 - Tide file

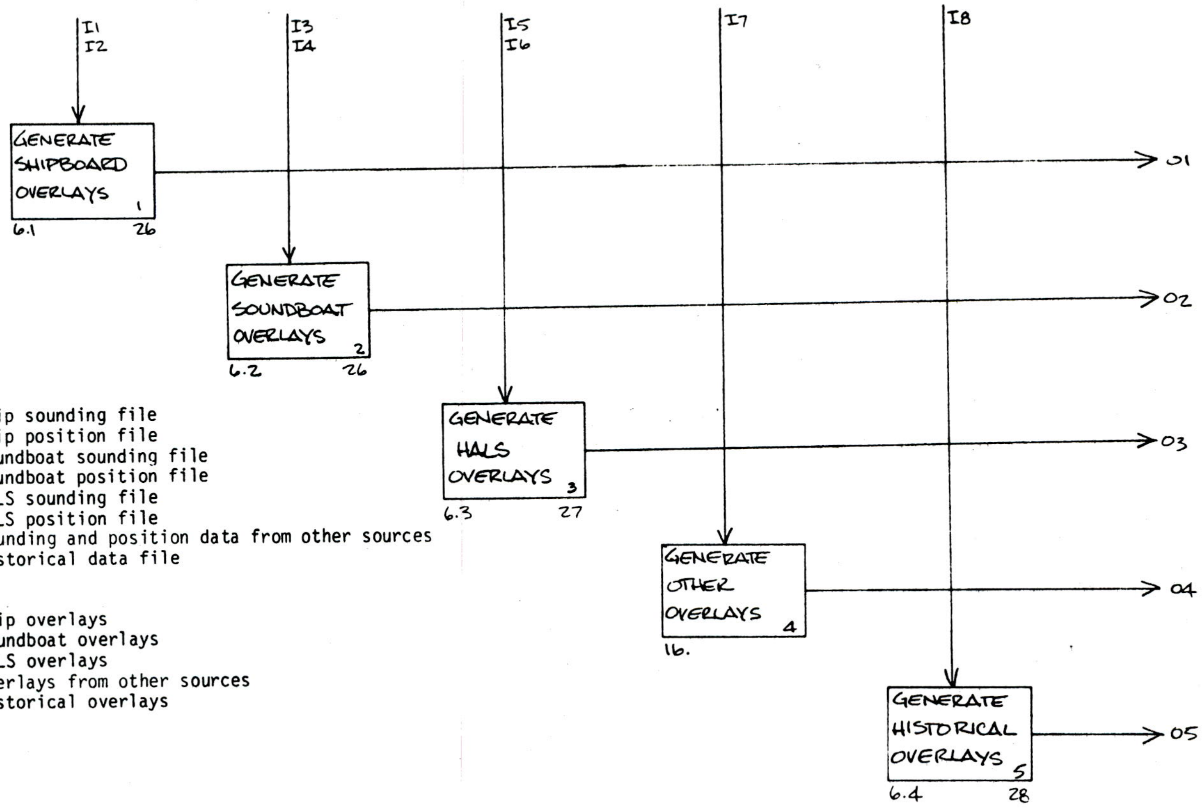
Intermediate:
- 1 - Depth overlays
- 2 - Position overlays
- 3 - Consistent overlays
- 4 - Evaluated field sheet file
- 5 - Non-annotated field sheet file
- 6 - Annotated field sheet file

Output:
- 01 - Orders to re-survey
- 02 - Completed field sheet file
- 03 - Edited field sheet file

NODE: 3.1

NUMBER: 25

GENERATE OVERLAY SHEETS

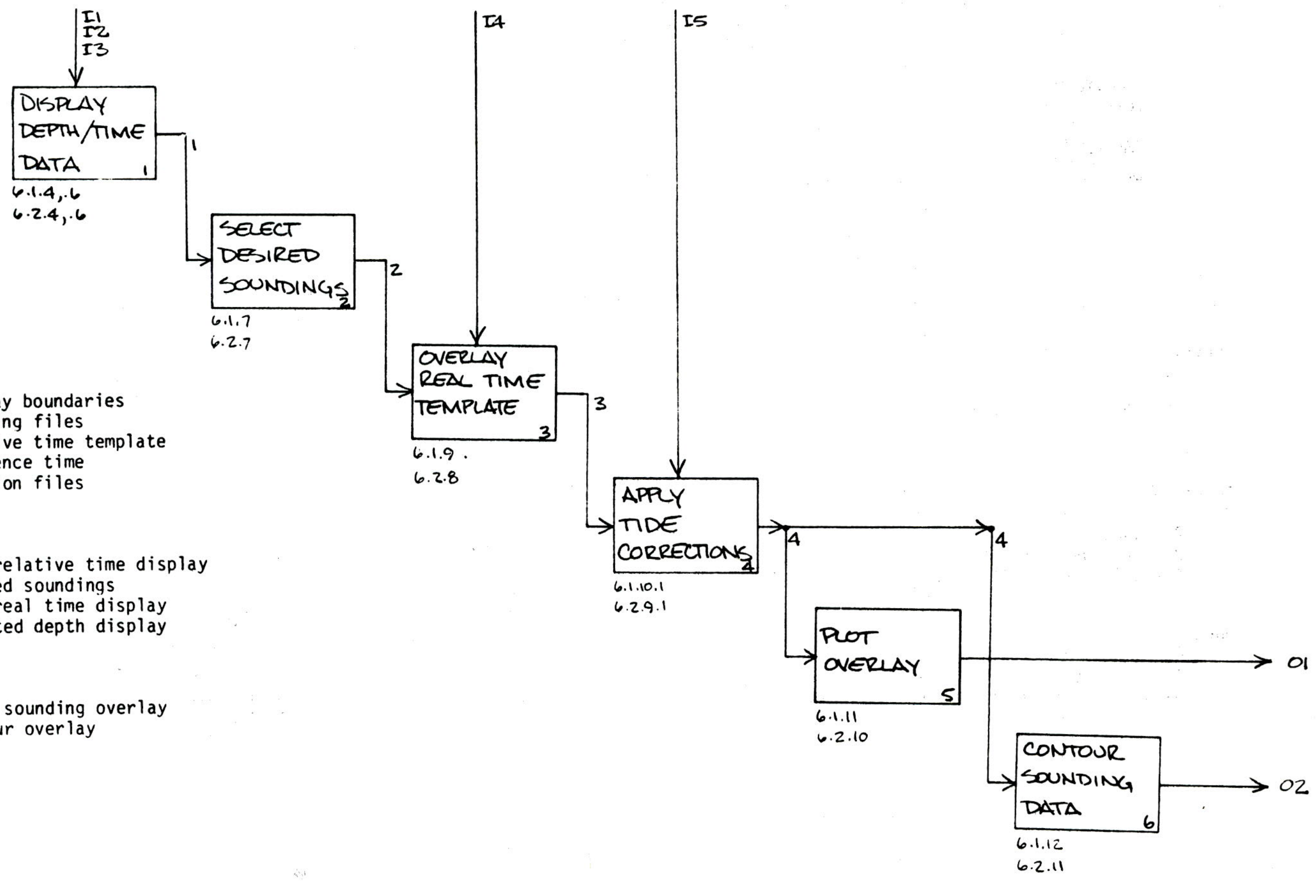


Input:
- I1 - Ship sounding file
- I2 - Ship position file
- I3 - Soundboat sounding file
- I4 - Soundboat position file
- I5 - HALS sounding file
- I6 - HALS position file
- I7 - Sounding and position data from other sources
- I8 - Historical data file

Output:
- 01 - Ship overlays
- 02 - Soundboat overlays
- 03 - HALS overlays
- 04 - Overlays from other sources
- 05 - Historical overlays

NODES: 3.1.1, 3.1.2
NUMBER: 26

GENERATE SHIP/SOUNDBOAT OVERLAYS



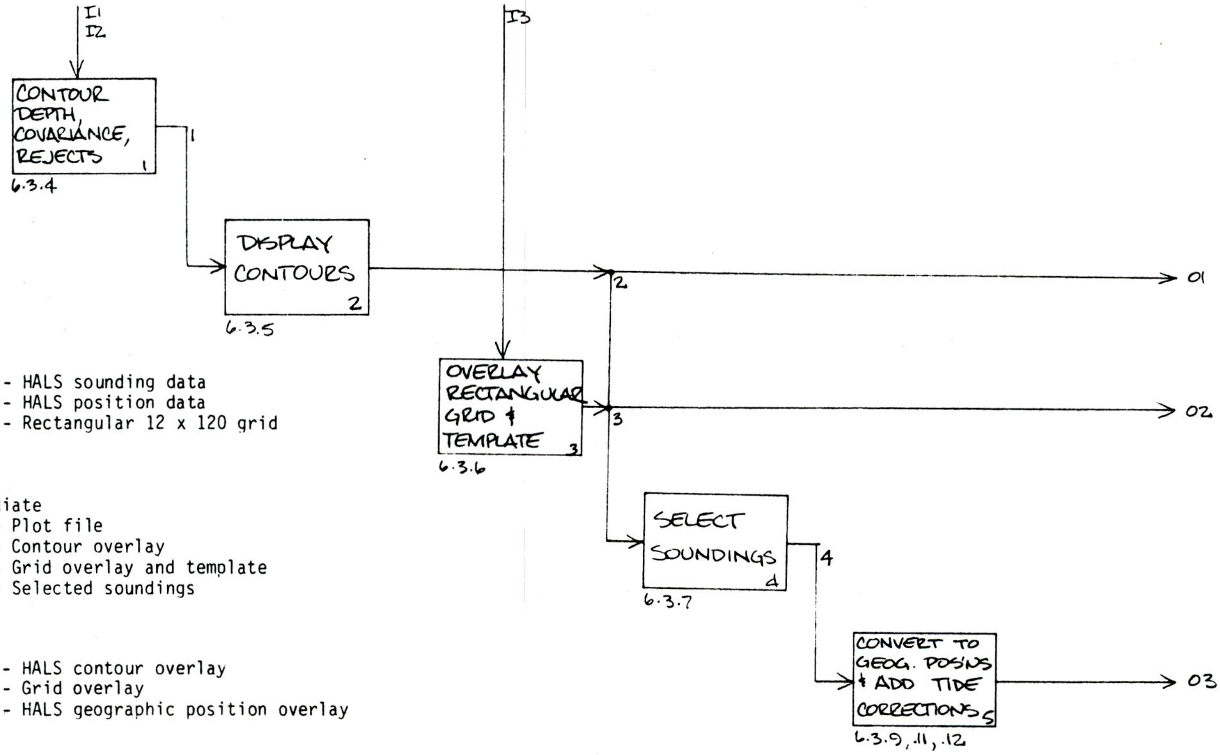
Input:
- I1 - Overlay boundaries
- I2 - Sounding files
- I3 - Relative time template
- I4 - Reference time
- I5 - Position files

Intermediate:
- 1 - Depth/relative time display
- 2 - Selected soundings
- 3 - Depth/real time display
- 4 - Corrected depth display

Output:
- O1 - Mylar sounding overlay
- O2 - Contour overlay

NODE: 3.1.3
NUMBER: 27

GENERATE HALS OVERLAYS



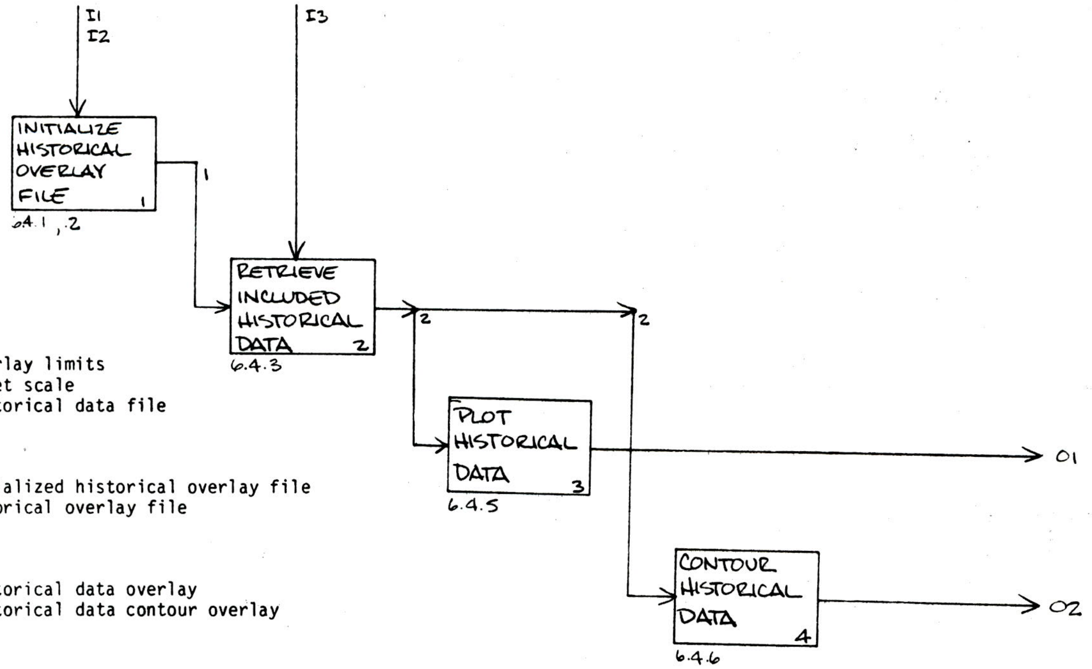
Input:
- I1 - HALS sounding data
- I2 - HALS position data
- I3 - Rectangular 12 x 120 grid

Intermediate
- 1 - Plot file
- 2 - Contour overlay
- 3 - Grid overlay and template
- 4 - Selected soundings

Output:
- O1 - HALS contour overlay
- O2 - Grid overlay
- O3 - HALS geographic position overlay

NODE: 3.1.4
NUMBER: 28

GENERATE HISTORICAL OVERLAYS



Input:
- I1 - Overlay limits
- I2 - Sheet scale
- I3 - Historical data file

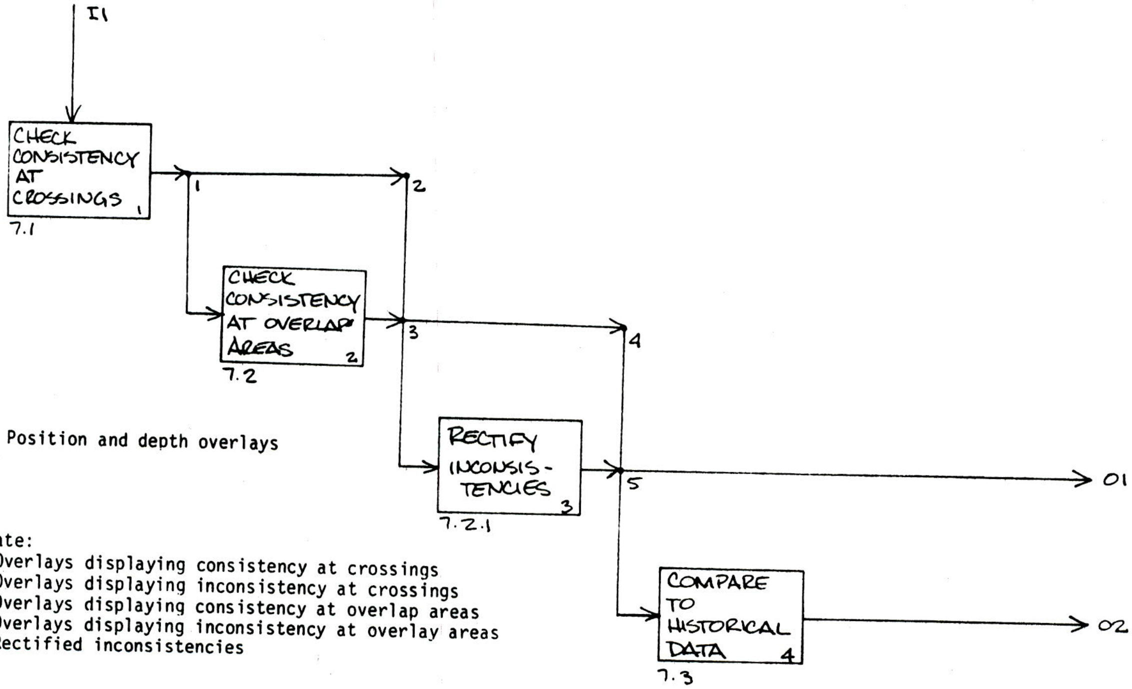
Intermediate:
- 1 - Initialized historical overlay file
- 2 - Historical overlay file

Output:
- O1 - Historical data overlay
- O2 - Historical data contour overlay

NODE: 3.2

NUMBER: 29

INSURE OVERLAY CONSISTENCY



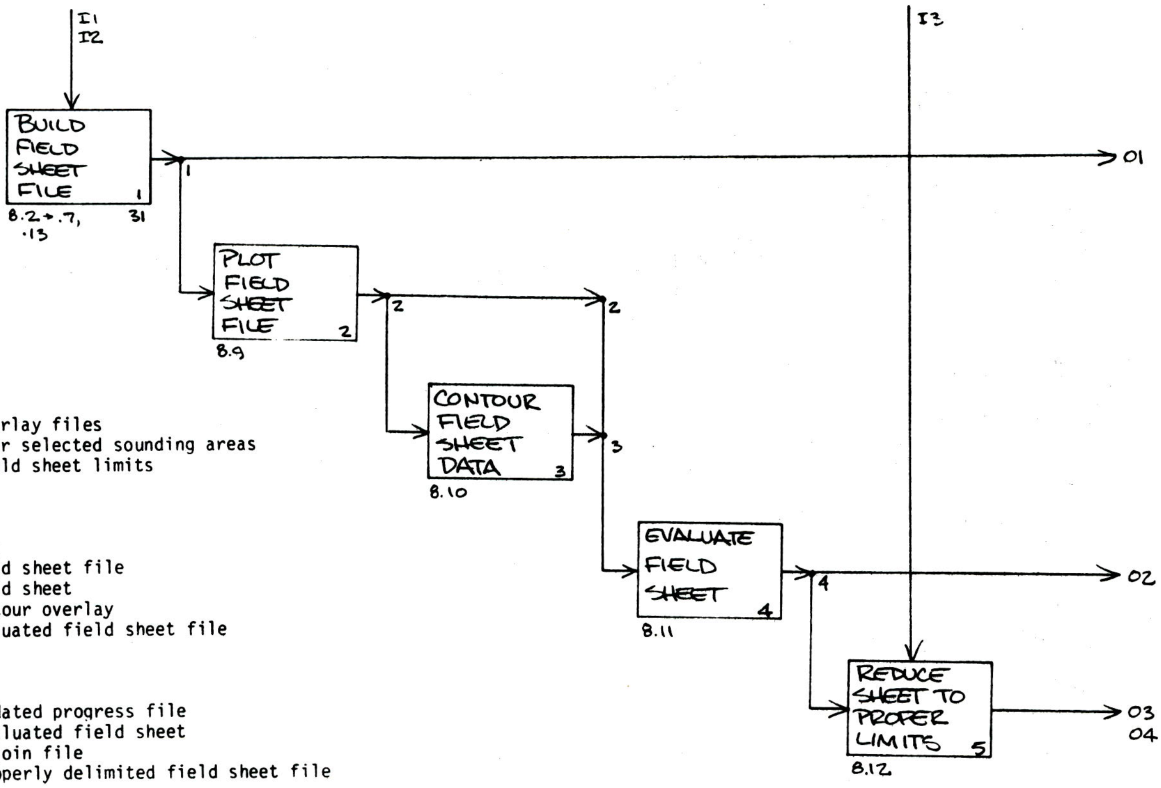
Input:
- I1 - Position and depth overlays

Intermediate:
- 1 - Overlays displaying consistency at crossings
- 2 - Overlays displaying inconsistency at crossings
- 3 - Overlays displaying consistency at overlap areas
- 4 - Overlays displaying inconsistency at overlay areas
- 5 - Rectified inconsistencies

Output:
- 01 - Orders to re-survey
- 02 - Consistent overlays

NODE: 3.3
NUMBER: 30

GENERATE FIELD SHEET FILE



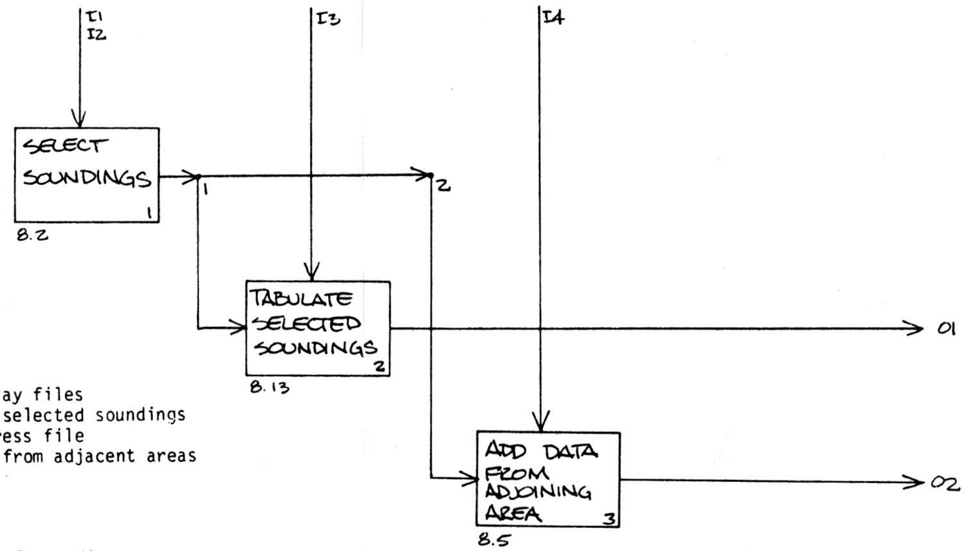
Input:
- I1 - Overlay files
- I2 - User selected sounding areas
- I3 - Field sheet limits

Intermediate:
- 1 - Field sheet file
- 2 - Field sheet
- 3 - Contour overlay
- 4 - Evaluated field sheet file

Output:
- 01 - Updated progress file
- 02 - Evaluated field sheet
- 03 - Adjoin file
- 04 - Properly delimited field sheet file

NODE: 3.3.1
NUMBER: 31

BUILD FIELD SHEET FILE



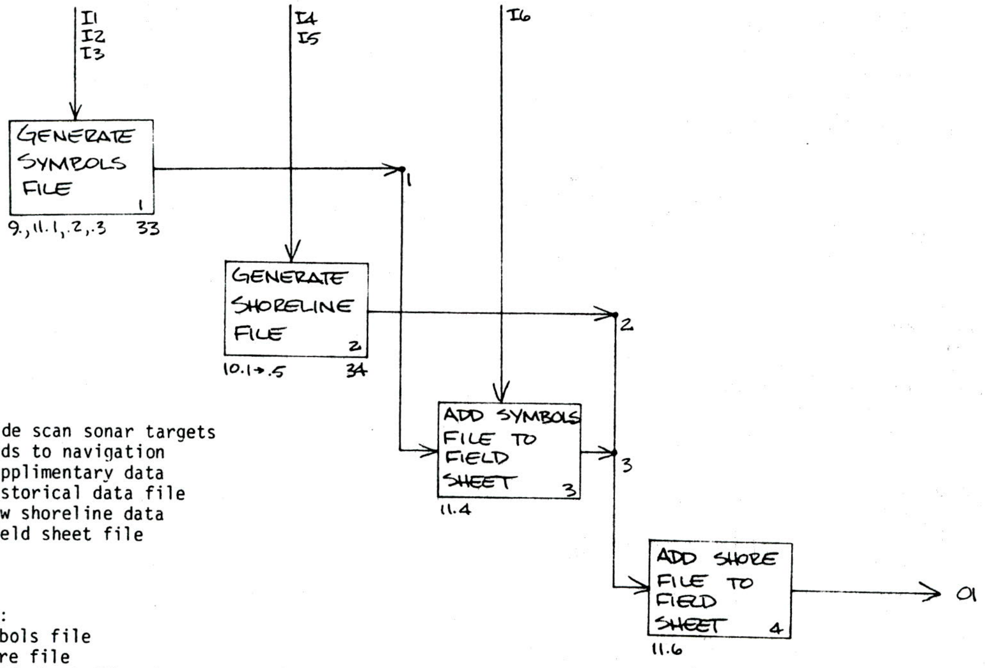
Input:
- I1 - Overlay files
- I2 - User selected soundings
- I3 - Progress file
- I4 - Data from adjacent areas

Intermediate:
- 1 - Count of soundings
- 2 - Partial field sheet file

Output:
- 01 - Updated progress file
- 02 - Field sheet file

NODE: 3.4
NUMBER: 32

ADD SHORE AND SYMBOLS DATA



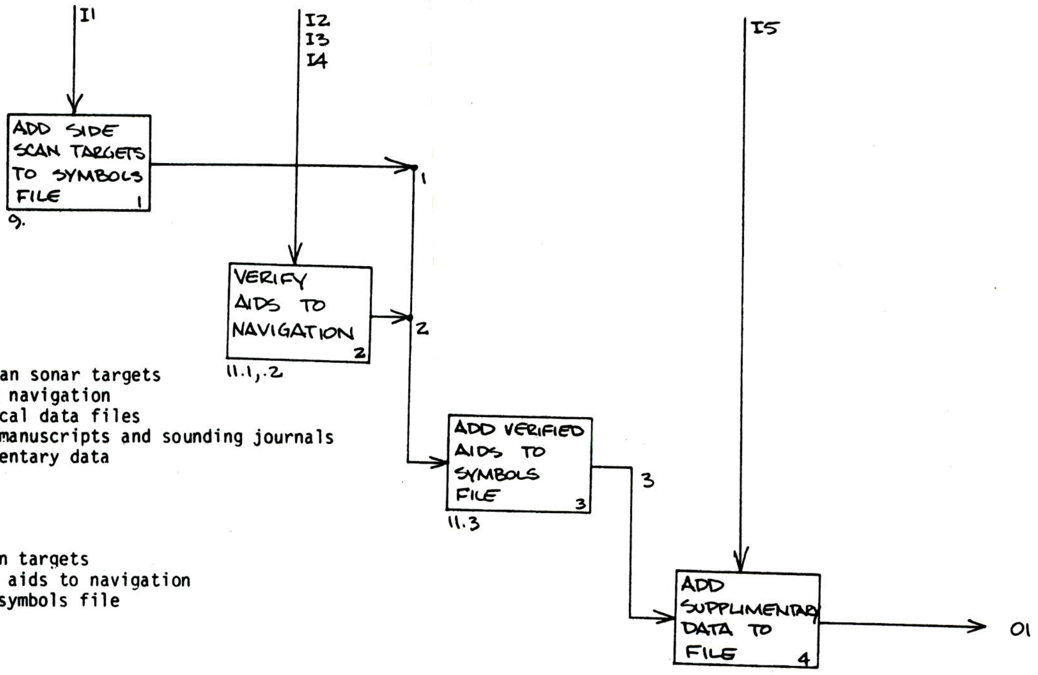
Input:
- I1 - Side scan sonar targets
- I2 - Aids to navigation
- I3 - Supplimentary data
- I4 - Historical data file
- I5 - New shoreline data
- I6 - Field sheet file

Intermediate:
- 1 - Symbols file
- 2 - Shore file
- 3 - Field sheet file with symbols data

Output:
- 01 - Non-annotated field sheet file

NODE: 3.4.1
NUMBER: 33

GENERATE SYMBOLS FILE



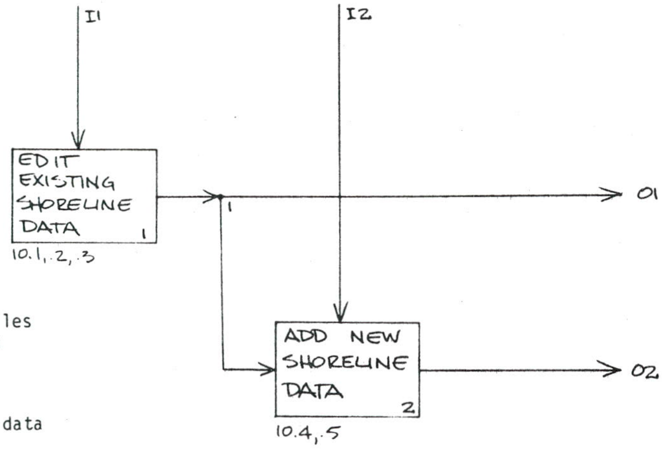
Input:
- I1 - Side scan sonar targets
- I2 - Aids to navigation
- I3 - Historical data files
- I4 - Survey manuscripts and sounding journals
- I5 - Supplementary data

Intermediate:
- 1 - Side scan targets
- 2 - Verified aids to navigation
- 3 - Partial symbols file

Output:
- O1 - Symbols file

NODE: 3.4.2
NUMBER: 34

GENERATE SHORELINE FILE



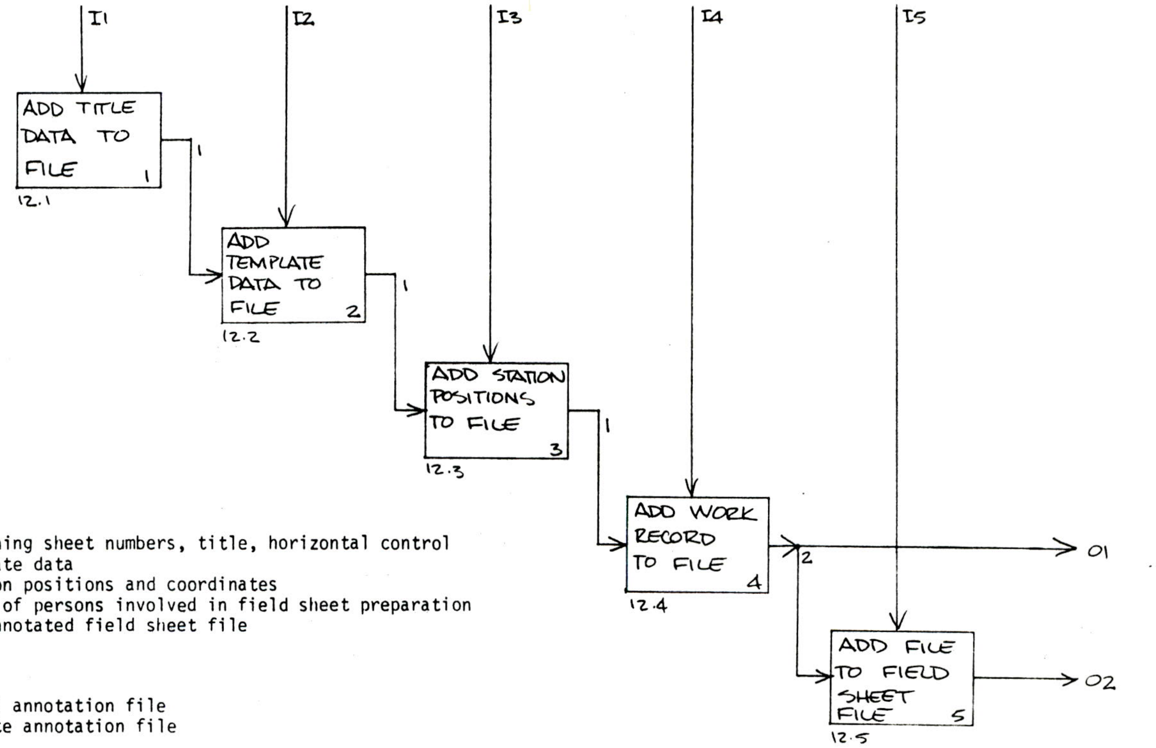
Input:
- I1 - Historical data files
- I2 - New shoreline data

Intermediate:
- 1 - Existing shoreline data

Output:
- 01 - Shore file containing historical data only
- 02 - Shore file containing historical and new data

NODE: 3.5
NUMBER: 35

ADD ANNOTATION DATA



Input:
- I1 - Adjoining sheet numbers, title, horizontal control
- I2 - Template data
- I3 - Station positions and coordinates
- I4 - Names of persons involved in field sheet preparation
- I5 - Non-annotated field sheet file

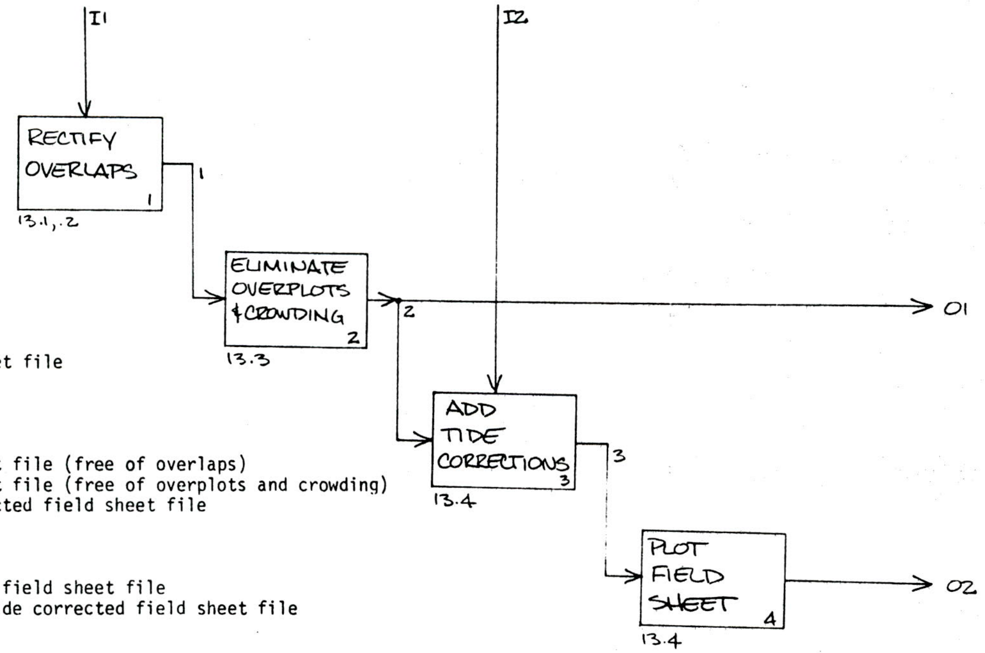
Intermediate:
- 1 - Partial annotation file
- 2 - Complete annotation file

Output:
- 01 - Management file
- 02 - Annotated field sheet file

NODE: 3.6

NUMBER: 36

EDIT FIELD SHEET



Input:
- I1 - Field sheet file
- I2 - Tide file

Intermediate:
1 - Field sheet file (free of overlaps)
2 - Field sheet file (free of overplots and crowding)
3 - Tide corrected field sheet file

Output:
- O1 - Completed field sheet file
- O2 - Plot of tide corrected field sheet file

4.4 SMOOTH SHEET PREPARATION

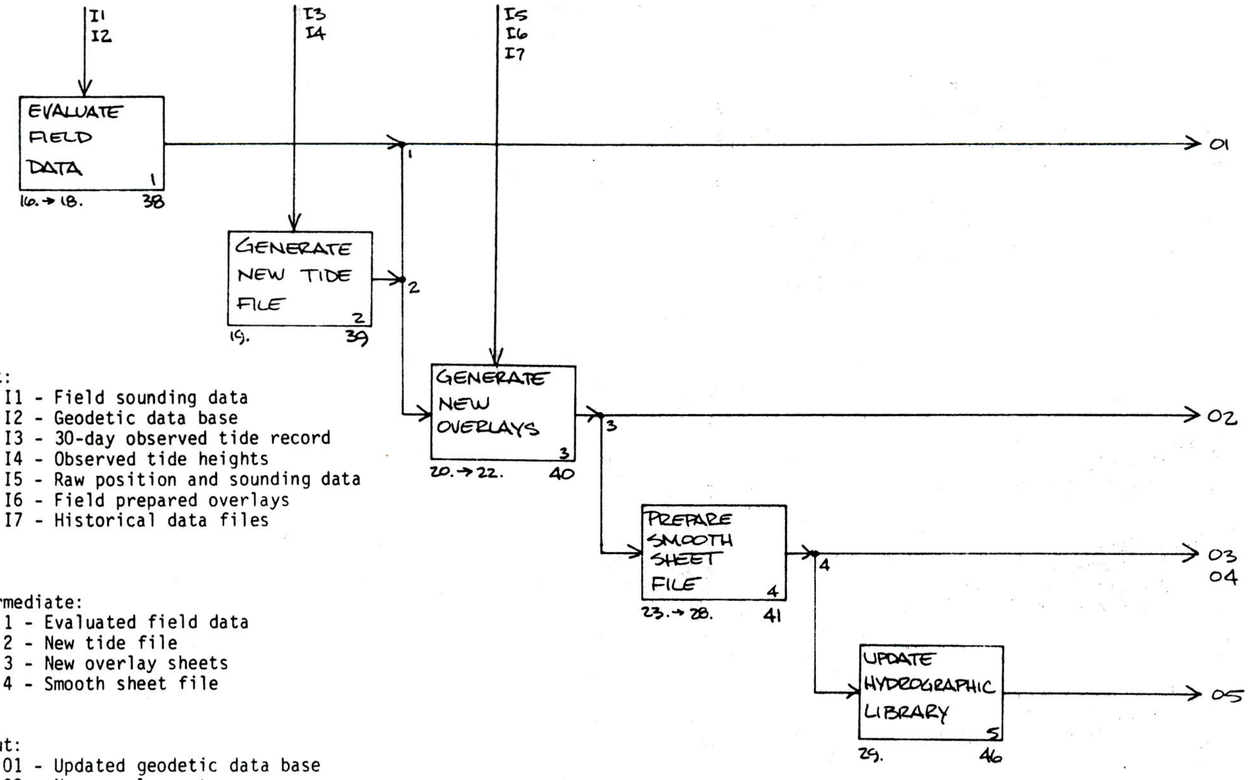
Smooth sheet preparation is broken into the following five functions as shown in diagram 37.

- Evaluate Field Data
- Generate New Tide File
- Regenerate Overlays
- Prepare Smooth Sheet Files
- Plot Smooth Sheet

These functions correspond to tasks 16 through 29 of the Scenario (see Appendix 5) and are described in diagrams 38 through 46.

NODE: 4
NUMBER: 37

PREPARE SMOOTH SHEET



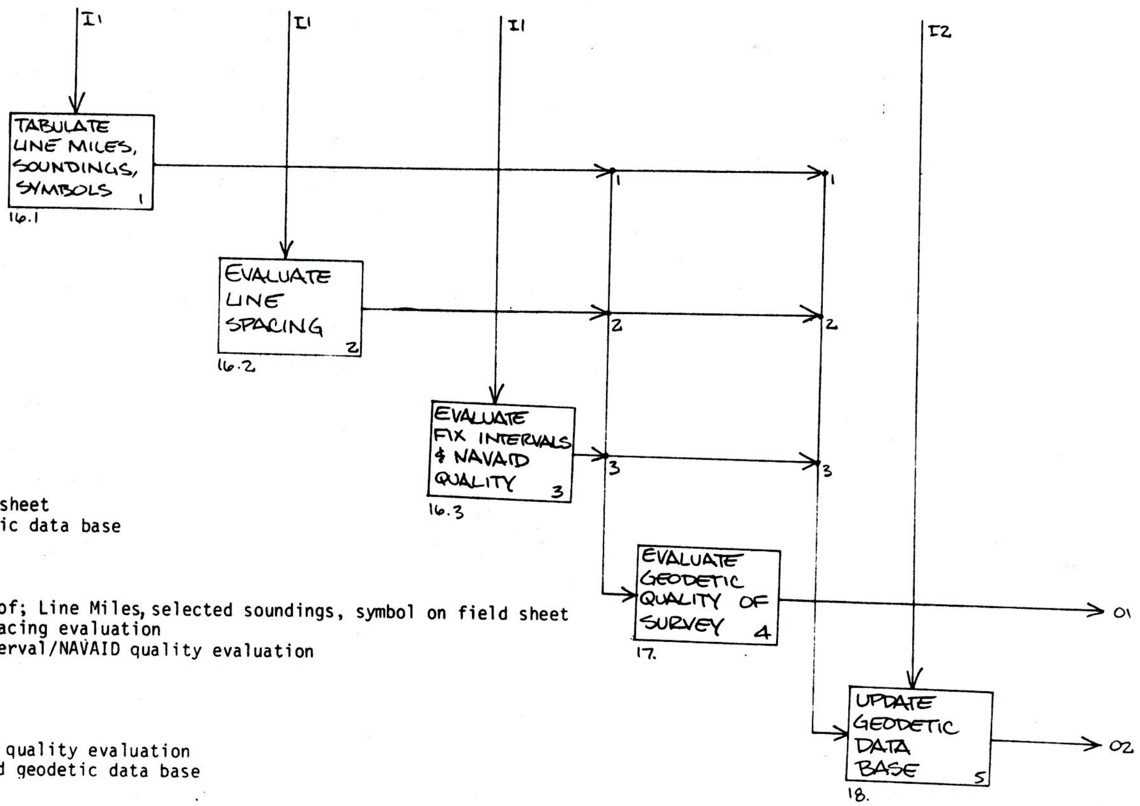
Input:
- I1 - Field sounding data
- I2 - Geodetic data base
- I3 - 30-day observed tide record
- I4 - Observed tide heights
- I5 - Raw position and sounding data
- I6 - Field prepared overlays
- I7 - Historical data files

Intermediate:
- 1 - Evaluated field data
- 2 - New tide file
- 3 - New overlay sheets
- 4 - Smooth sheet file

Output:
- 01 - Updated geodetic data base
- 02 - New overlay set
- 03 - Smooth sheet file
- 04 - Smooth sheet
- 05 - Updated library files

NODE: 4.1
NUMBER: 38

EVALUATE FIELD DATA



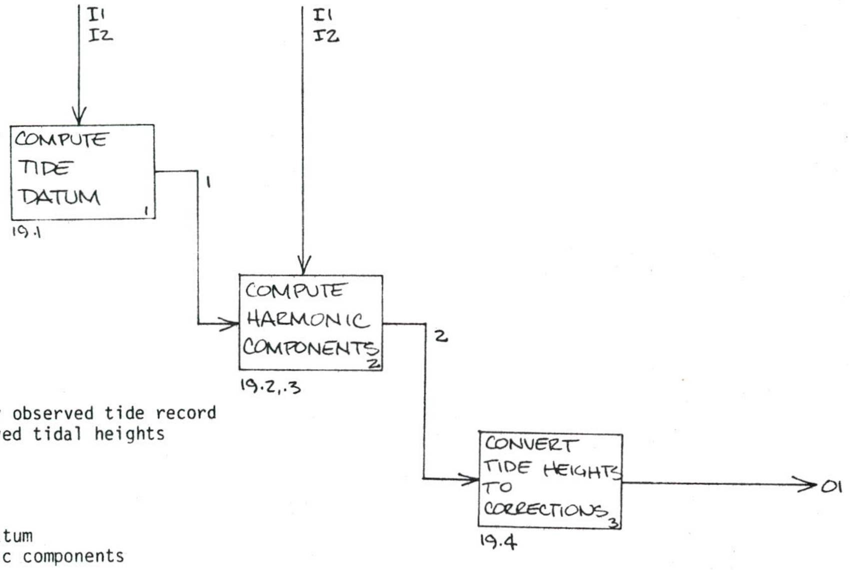
Input:
- I1 - Field sheet
- I2 - Geodetic data base

Intermediate:
- 1 - Number of; Line Miles, selected soundings, symbol on field sheet
- 2 - Line spacing evaluation
- 3 - Fix interval/NAVAID quality evaluation

Output:
- O1 - Survey quality evaluation
- O2 - Updated geodetic data base

NODE: 4.2
NUMBER: 39

GENERATE NEW TIDE FILE



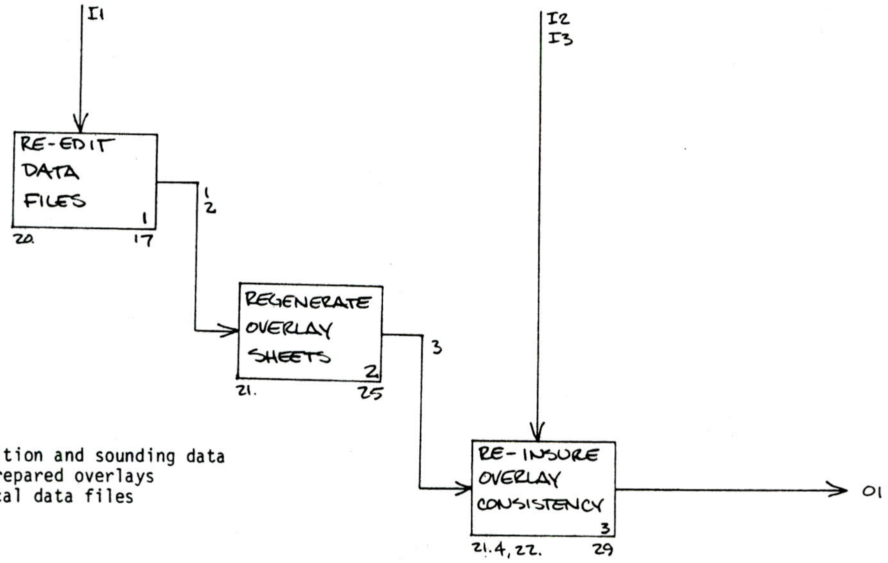
Input:
- I1 - 30 day observed tide record
- I2 - Observed tidal heights

Intermediate:
- 1 - Tide datum
- 2 - Harmonic components

Output:
- O1 - New tide file

NODE: 4.3
NUMBER: 40

REGENERATE OVERLAYS



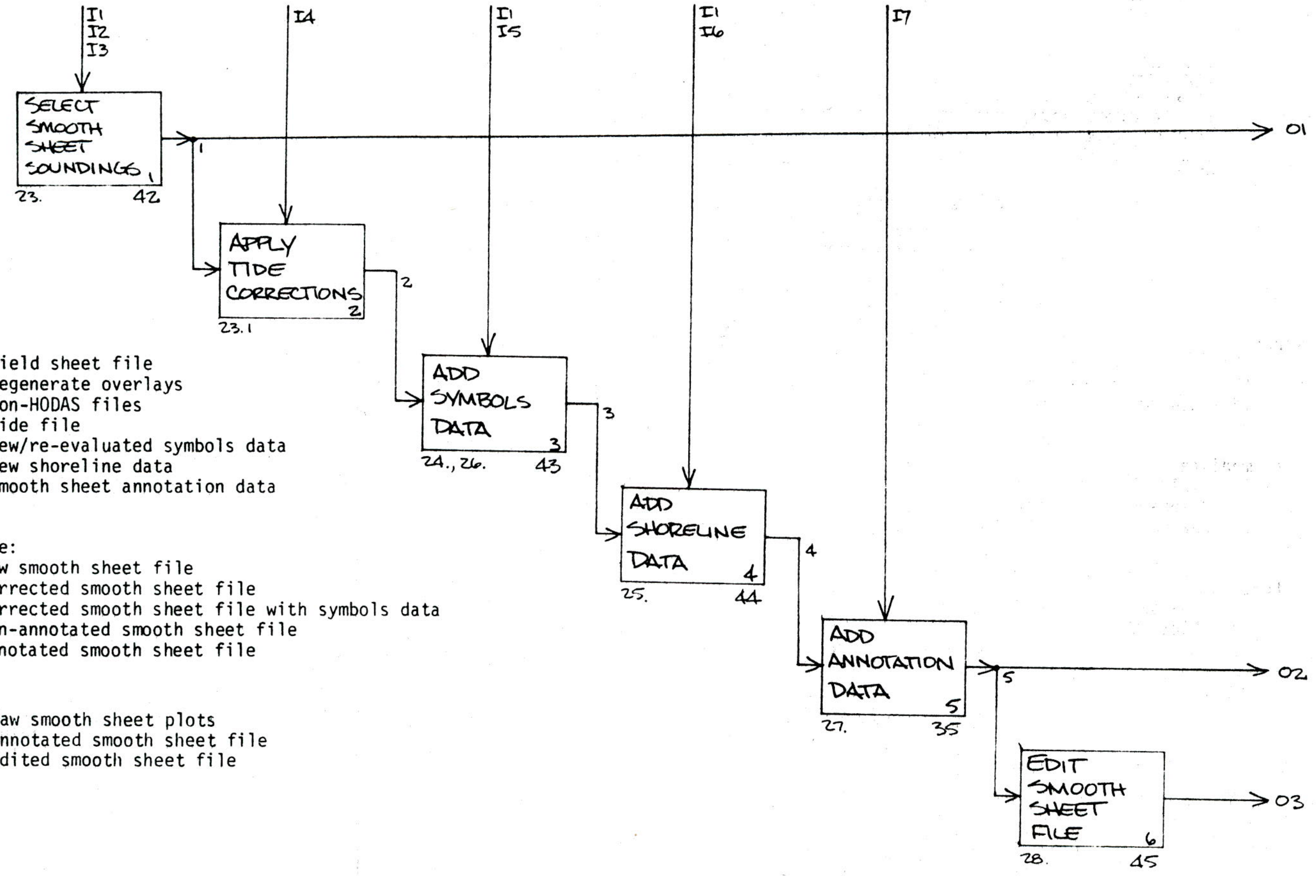
Input:
- I1 - Raw position and sounding data
- I2 - Field prepared overlays
- I3 - Historical data files

Intermediate:
- 1 - Edited position data
- 2 - Edited sounding data
- 3 - New overlays

Output:
- O1 - New overlay set

NODE: 4.4
NUMBER: 41

PREPARE SMOOTH SHEET FILE



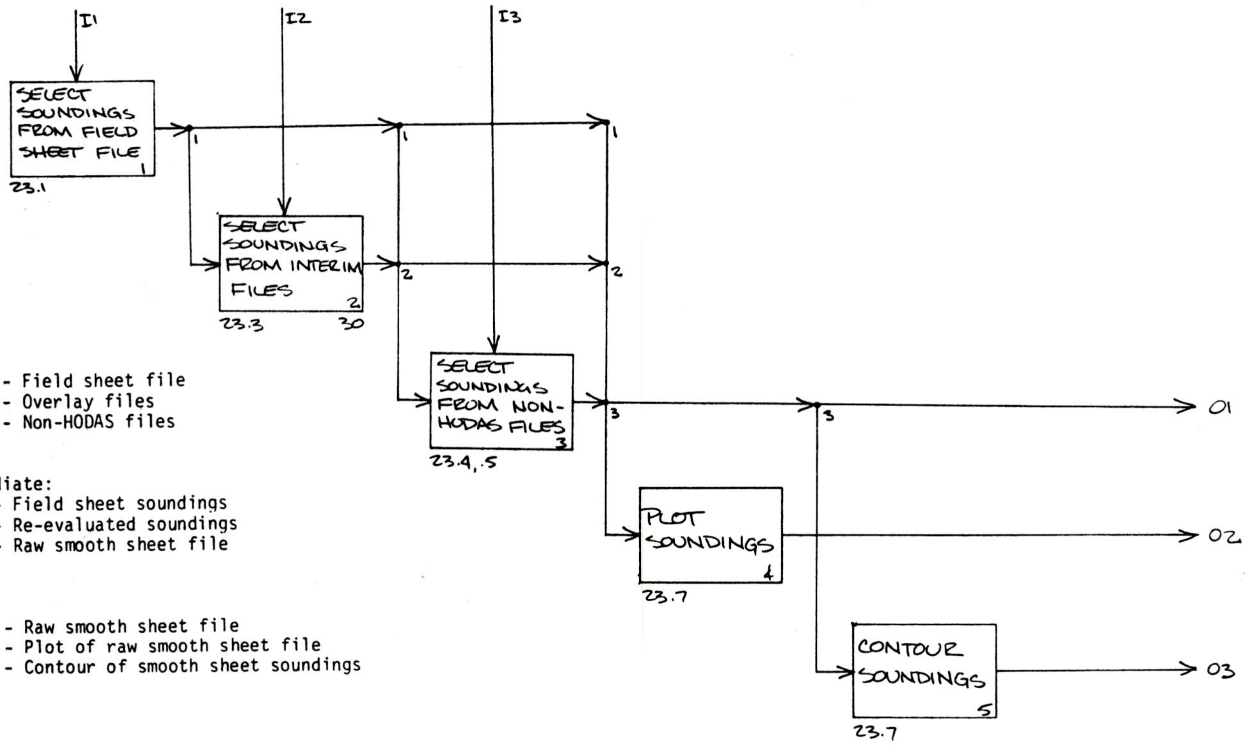
Input:
- I1 - Field sheet file
- I2 - Regenerate overlays
- I3 - Non-HODAS files
- I4 - Tide file
- I5 - New/re-evaluated symbols data
- I6 - New shoreline data
- I7 - Smooth sheet annotation data

Intermediate:
- 1 - Raw smooth sheet file
- 2 - Corrected smooth sheet file
- 3 - Corrected smooth sheet file with symbols data
- 4 - Non-annotated smooth sheet file
- 5 - Annotated smooth sheet file

Output:
- 01 - Raw smooth sheet plots
- 02 - Annotated smooth sheet file
- 03 - Edited smooth sheet file

NODE: 4.4.1 NUMBER: 42

SELECT SMOOTH SHEET SOUNDINGS



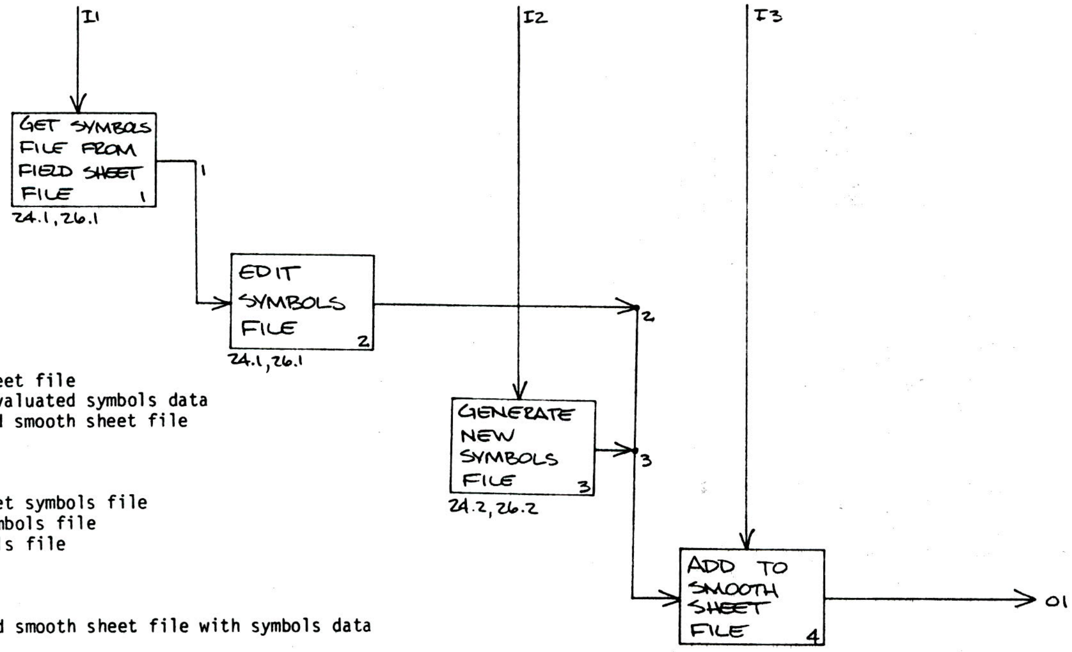
Input:
- I1 - Field sheet file
- I2 - Overlay files
- I3 - Non-HODAS files

Intermediate:
- 1 - Field sheet soundings
- 2 - Re-evaluated soundings
- 3 - Raw smooth sheet file

Output:
- 01 - Raw smooth sheet file
- 02 - Plot of raw smooth sheet file
- 03 - Contour of smooth sheet soundings

NODE: 4.4.3 | ADD SYMBOLS DATA TO SMOOTH SHEET FILE

NUMBER: 43

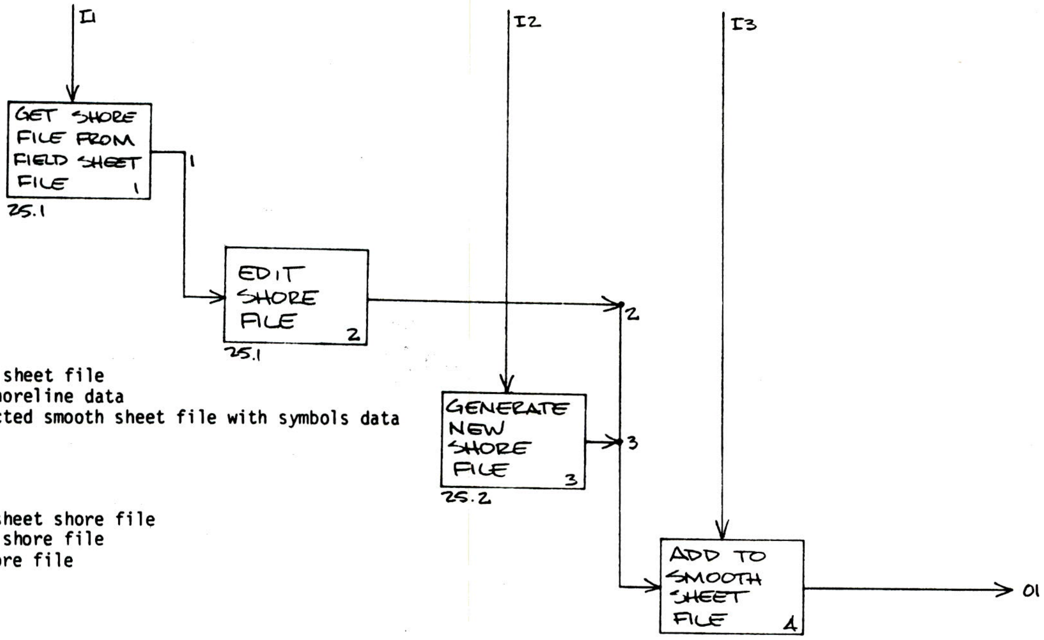


Input:
- I1 - Field sheet file
- I2 - New/re-evaluated symbols data
- I3 - Corrected smooth sheet file

Intermediate:
- 1 - Field sheet symbols file
- 2 - Edited symbols file
- 3 - New symbols file

Output:
- 01 - Corrected smooth sheet file with symbols data

NODE: 4.4.4 | ADD SHORELINE DATA TO SMOOTH SHEET FILE
NUMBER: 44



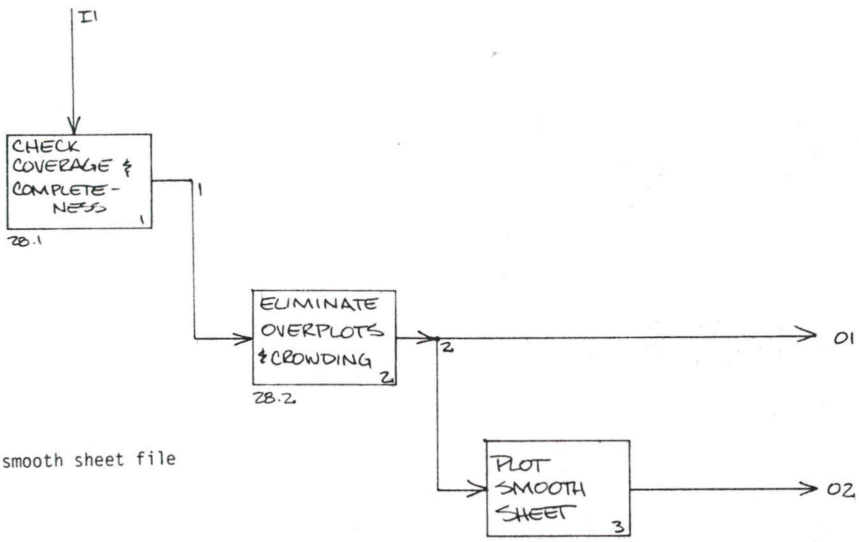
Input:
I1 - Field sheet file
I2 - New shoreline data
I3 - Corrected smooth sheet file with symbols data

Intermediate:
1 - Field sheet shore file
2 - Edited shore file
3 - New shore file

Output:
O1 - Non-annotated smooth sheet file

NODE: 4.4.6
NUMBER: 45

EDIT SMOOTH SHEET FILE



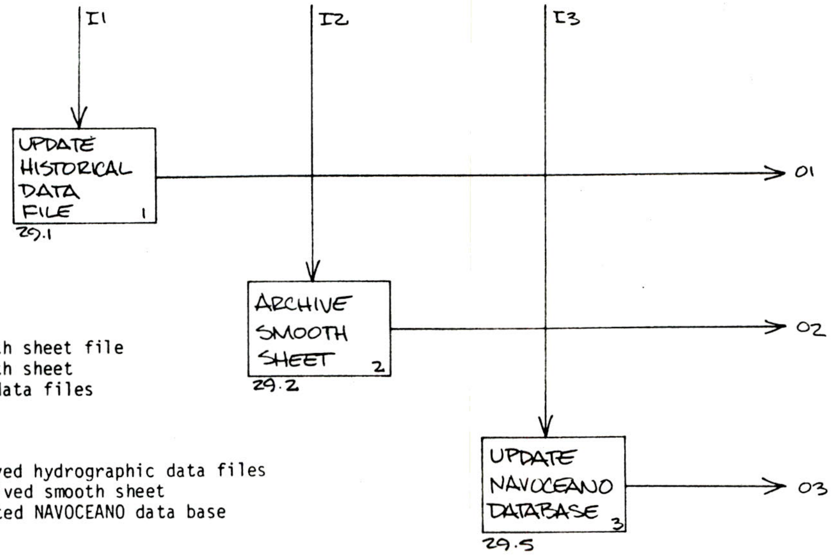
Input:
    I1 - Annotated smooth sheet file

Intermediate
    1 - Partially edited smooth sheet file
    2 - Smooth sheet file

Output:
    01 - Smooth sheet file
    02 - Smooth sheet

NODE: 4.5
NUMBER: 46

UPDATE HYDROGRAPHIC LIBRARY



Input:
- I1 - Smooth sheet file
- I2 - Smooth sheet
- I3 - All data files

Output:
- 01 - Updayed hydrographic data files
- 02 - Archived smooth sheet
- 03 - Updated NAVOCEANO data base

APPENDIX 1

DESCRIPTION OF STRUCTURED ANALYSIS

DATA FLOW DIAGRAMS

DESCRIPTION OF STRUCTURED ANALYSIS

DATA FLOW DIAGRAMS

Structured Analysis Data Flow Diagrams (DFDs) are one of several tools utilized in the structured approach to system specification and design. These diagrams are constructed from the data's point of view and at this point in the development, represent the functions to be performed by the system. In other words, they represent the logical design of the system.

The DFDs are heirarchical in nature in that each layer is more detailed than the preceding layer and less detailed than the succeeding layer. This decomposition is continued for each function until a level of detail sufficient for the application is reached. (Each function is not necessarily broken into the same number of levels.)

In order to get the most information out of a Structured Analysis, the reader should attempt to understand the system one level at a time, proceeding from the highest level to the lowest level. This technique will help the reader avoid being overwhelmed by a flood of unorganized detail.

PHYSICAL PROPERTIES:

- Each node is named to reflect its 'parent' node. For example, node 1.2 is the decomposition of process 2 of node 1.

- The nodes are numbered sequentially.

- Input to a process box from outside a node enters the process box at the top.

- Input from other process boxes inside a node enters the process from the left.

- Output from the node leaves the process box on the right and exits the diagram on the right.

- Output from one process to be used as input to another process in the same node also leaves the process box from the right.

- The number of the diagram representing the decomposition of a given process is shown under the lower right hand corner of the diagram.

- The number(s) of the corresponding Scenario task(s) (see Appendix 5) are shown under the lower left hand corner of the process.

APPENDIX 2

TERMS AND ABBREVIATIONS

TERMS AND ABBREVIATIONS

Archive Number	A six digit number assigned to a survey
Bathymetry	The science of determining and interpreting ocean depths and topography
BCD	Binary Coded Decimal
BDLS	Boat Data Logger System
Boat Sheet	See Field Sheet
Calibration Sheet	Sheet required for calibrating an electronic positioning system for manual methods
Cartographic Feature	The natural or cultural objects shown on a map or chart
Console	The unit of a computer where the major monitoring and control functions are done
Contour Line	A line on a map or chart connecting points of equal elevation or depth
Database	An indexed and/or cross-indexed set of related data files.
Depth	A vertical distance from a given water level to the bed of a sea, lake, or river
DMAHTC	Defense Mapping Agency Hydrographic Topographic Center
DoD	Department of Defense
Easting	A linear distance eastward from the vertical grid line which passes through the origin of a grid system
Echogram	A graphic record (analog strip chart) of the bottom profile produced from echo sounders
Editing	The process of checking a map or chart in its various stages of preparation to insure accuracy, completeness, and correct preparation from and interpretation of the sources used, and to insure legible and precise reproduction
Ephemeris	A publication, data or ADP file giving coordinates of celestial bodies at uniform time intervals; the coordinates are usually given for one calendar year. Also used for satlellite orbital parameters.

Field Reports	Reports from the field providing general activities, status, progress, and accomplishments of all hydrographic survey units
Field Sheets	Worksheet that graphically displays the hydrographer's representation of surface and subsurface features in the area being surveyed
Fix	A position determined from terrestrial, electronic, or astronomical data
Geodetic Position	A position of a point on the surface of the earth expressed in terms of latitude and longitude
GP	Geographic Position or Geodetic Position
HALS	Hydrographic Airborne Laser Sounder
HDAS	Hydrographic Data Acquisition System
HODAS	Hydrographic Oceanographic Data Acquisition System
Hydrography	That science which deals with the measurement and description of the physical features of the oceans, lakes, rivers, and their adjoining coastal areas with particular reference to their use for navigational purposes
HYAIS	Hydrographic Automated Information System
I/O	Input/Output
IGE	Interactive Graphic Editing
Latitude	An angular distance measured north or south of the equator on a shere or spheroid
Leveling	The operation of measuring vertical distances, directly or indirectly, to determine elevations
Longitude	An angular distance measured east to west from a reference meridian on a sphere or spheroid
LSD	Least Significant Digit
MSD	Most Significant Digit
Nautical Chart	A hydrographic chart showing depths of water, nature of the bottom, contours of bottom, coastline, and tides and currents in a given sea or sea land area, along with any permanent or semi-permanent navigation aids.

Northing	A linear distance northward from the horizontal grid line which passes through the origin of the grid system.
PT	Post Time
NAVOCEANO	U.S. Naval Oceanographic Office
Overlay	A printing or drawing on a transparent or translucent medium at the same scale as a map, chart, or other graphic
Position	Data which define the location of a point with respect to a reference system
RT	Real Time
Scale	The ratio of a distance on a photograph, map or other graphic to its corresponding distance on the ground or to another graphic
Smooth Sheet	A final plot of field control and hydrographic development
Sounding Journal	A time record for recurring series of events
Target Analysis	An examination of potential targets
Terminal (Teletype)	A remote device which supplies input to and receives output from a computer
Tide	The periodic rise and fall of the surface of the ocean resulting from gravitational attraction of the moon and sun acting upon the rotating earth
Track	The actual path of a ship on the surface of the earth
TTY	Teletype
UTM	Universal Transverse Mercator grid
Variable	The representation of a quantity which can assume any of a given set of values

APPENDIX 3

REQUIRED HYAIS CAPABILITIES

HYAIS

The HIHAN in-house processing scheme requires the HYAIS to have the following capabilities:

- Color Graphics Editing
- Data Processing

The data processing capability is required in order to perform the computations necessary to process and merge any raw or partially processed data from the ship. The data processing capability is also required to apply the reducers not available for shipboard processing.

This required data processing capability is generally not available as part of a color graphics terminal. While it may be possible to configure a system which uses the UNIVAC 1100/82 as host to the graphics terminals, it would be preferable to interface the color graphics terminals, tape readers, etc. to a mini-computer. This mini can then be interfaced to the UNIVAC Mainframe. This type of configuration permits faster more efficient access to the data being processed. The mainframe's primary functions in such a configuration are to house large data files and to perform any processing requiring a large number of computations.

APPENDIX 4

DATA STORAGE REQUIREMENTS

The HIHAN system must be capable of handling the following volumes of raw data from each of the acquisition systems.

- Mother Ship Raw Data - Will contain approximately 250K words per day of data collection. This assumes a sample rate of 60 samples per minute.

- Soundboat Raw Data - Will contain approximately 40K words per 8 hour day of data collection per boat. This assumes a sample rate of 60 points per minute.

- HALS Data - The processed HALS data used as input to HIHAN will contain approximately 205K words per mission (see Jan. '82 "Draft of HALS Post Processing Software Design", a NORDA Technical Note by H. J. Byrnes).

The volume of processed data will be less than that of the raw data and will be dependent on the planned final chart scale.

APPENDIX 5

HIHAN SCENARIO TASKS

TASK	HIHAN FUNCTION MODULE	MODULE INPUT	MODULE OUTPUT	STRUCTURAL ANALYSIS NODE	NODE INPUT	NODE OUTPUT
1.0 Survey requests are received, area requirements are analyzed, new surveys are designed, and Hydrographic Projet Instructions are issued.	--	--	--	0	11	1,2,3
1.1 Survey area planning charts with prominent geographic and bathymetric features are obtained and analyzed.	Manual	--	--	1	11,12	1-4
1.2 Tide gauge monitor positions are planned.	Manual	--	--	1	1	5
1.3 Survey navigation is planned and NAVAID sites are evaluated.	--	--	--	1	2	6
1.3.1 Generate reliability diagrams.	HFM 1	1	2	1.3	11	1
1.3.2 Evaluate net geometry.	Manual	--	--	1.3	1	01
1.4 Historical data base files are prepared for area.	--	--	--	1	13,3	1
1.4.1 Search digitized files for historical data in general area of survey and enter on Historical Data Base File.	HFM 2	3	4	1.4.1	11	1
1.4.2 If no digitized shoreline is available, digitize from existing DMA-furnished shoreline manuscripts or charts, duplicate, and enter onto Historical Data Base File.	HFM 3	5	3,4	1.4.1	12	2
1.4.3 If no existing shoreline manuscripts or charts, U.S. or foreign, arrange for photographs; area photography should be considered if available shoreline is not high quality.	HFM 4	5	3,4	1.4.1	13	3
1.4.4 Enter Aids to Navigation and Dangers to Navigation that are to be verified or investigated onto Historical Data Base File via keyboard or digitizer, if necessary.	HFM 5	1,2,3	3,4	1.4	15,16	2
1.4.5 Enter onto Historical Data Base File adjacent and overlapping smooth sheets from previous surveys.	HFM 6	3	4	1.4	17	01
1.4.6 If necessary, establish a digital Historical Data Base via keyboard or digitizing table entry from old smooth sheets or charts.	HFM 7	1,5	3,4	1.4.1	14	4
1.4.7 Write Historical Data Base File to tape and send to the Hydrographic Survey Detachment.	HFM 8	3	4	--	--	--
1.5 Hydrographic Projects Instructions are issued.	--	--	--	1	14,15	8,02
1.5.1 The purpose, location, time, security, affected charts, scope and quality of the survey are defined.	Manual	--	--	1.5.1	11	01
1.5.2 Unit participation and personnel responsibility are assigned. A commanding officer may be assigned overall responsibility for execution of the survey. The CO provides liaison between the ship's master, scientific personnel, and other participants. A Senior NAVOCEANO Scientist (SNS) supervises on-board NAVOCEANO civilian employees and advises the CO on technical survey matters.	Manual	--	--	1.5	14	02

TASK	HIHAN FUNCTION MODULE	MODULE INPUT	MODULE OUTPUT	STRUCTURAL ANALYSIS NODE	NODE INPUT	NODE OUTPUT
1.5.3 Proposed NAVAID transmitter sites are listed, site selection guidelines are prepared, and Horizontal and Vertical Control geodetic requirements are defined.	Manual	--	--	1.5	I10→I12	08,010
1.5.4 Instructions on verification of the existence, position, and elevation or depth of all topographic features (i.e., shoreline and charted detail, landmarks, nonfloating aids to navigation) are prepared.	Manual	--	--	1.5.1	I2	02
1.5.5 Tide/water level requirements are specified for survey support and for update to tide predictions; responsibility, continuity, benchmark requirements, gauge types, reports, data reduction standards, datum, and locations of primary and secondary gauges are defined.	Manual	--	--	1.5	I10→I12	08,010
1.5.6 Hydrography parameters and operations are defined:	Manual	--	--	1.5	I5→I9	04,07
1.5.6.1 Position control techniques, electronic positioning site characteristics, station calibration, and periodic lane identification techniques are specified.	Manual	--	--	1.5.4	I1 I3	01,03
1.5.6.2 Survey scales are specified and areas defined, sheet layout responsibility and construction specifications are issued and line spacing vs. depth and scale is specified.	Manual	--	--	1.5.4.2	I1-I3	01, 03
1.5.6.3 Spacing, crossing angle, and sounding agreement between sounding lines and crosschecks are specified.	Manual	--	--	1.5.4.2	I4,I5	04,05
1.5.6.4 Sounding units are specified, plotting techniques, and instructions for obtaining junction agreement at sheet edges are prepared.	Manual	--	--	1.5.4.2	I6 I8	06,07
1.5.6.5 Copies of prior surveys and Landsat imagery are forwarded and presurvey review items are established. The review items assign specific coordinates and items for investigation and a listing of shoal areas for investigation.	Manual	--	--	1.5.4	I5,I6	05
1.5.6.6 Instructions on Dangers to Navigation relative to development, positioning, survey resources allocation, and reporting procedure are prepared.	Manual	--	--	1.5.4	I7	06
1.5.6.7 Instructions for reducing the survey data are prepared.	Manual	--	--	1.5.4	I8	07
1.5.7 Bottom sampler type, classification procedure, and logging procedures are specified; current observation, depth, and locations in the survey area instructions and observation sites are prepared; XBT observation instructions are prepared.	Manual	--	--	1.5	2	03
1.5.8 Instructions for en route ocean track; verification of floating aids to navigation; sailing direction verification and/or correction; coastal navigation photography, and instructions on use of side scan sonar are prepared.	Manual	--	--	1.5.1	I3,I4,I5	03,04
1.5.9 Instructions for progress reports, report of survey on each smooth sheet, and SNR reports are prepared.	Manual	--	--	1.5	I4	02

TASK	HIHAN FUNCTION MODULE	MODULE INPUT	MODULE OUTPUT	STRUCTURAL ANALYSIS NODE	NODE INPUT	NODE OUTPUT
2.0 Hydrographic survey detachment arrives at the survey area, evaluates NAVAID sites, selects transmitter sites, establishes third-order geodetic control points for NAVAIDs, installs tide gauges, and acquires initial position calibration for the survey platforms via standard surveying practice.	Manual			1	8	03
2.1 Detachment computes NAVAID nets and plots boat sheets.	HFM 9 HODAS	1	2	1.6	I1, I2	01, 02
3.0 Detachment collects shipboard position and sounding data, soundboat position and sounding data, HALS position and sounding data, tide data, water quality data, current data, and bottom sediment classification data, shoreline data, aids/hazards to navigation data, and other information as required.	Manual	--	--	2	I1, I3	1, 6
3.1 The survey platforms return to a position reference to ensure lane identification ("calibration") as required.	Manual	--	--	2.1	I1 I3	01, 03
3.2 Daily: The Side Scan Sonar is checked for targets and, where warranted, additional survey development is planned and executed.	Manual	--	--	2.1	I4 I8	04
3.3 Tide data is acquired and its quality evaluated.	Manual	--	--	2.1	I9	05
3.4 Daily: Soundings and track are plotted and evaluated.	HFM 22 HODAS	7,8,9, 10,11	2	2.1	I10	06
4.0 A tide file is created via observed or predicted tides as data becomes available.	--	--	--	2	I→3 I4, I5	01
4.1 When tide gauge measurements are available in proximity to the survey tide variations (high, low, and intermediate heights) are scaled/digitized from the tide marigram and sent as input to a computer program which establishes the tide corrections and correlating time intervals; the corrections and times are then sent to the tide file.	HFM 10 HFM 11	5	6	2.2.2	I1	01
4.1.1 The datum from which gauge measurements are scaled is initially an estimated value; after 30 consecutive days of data is accumulated, a chart datum is computed and used instead of the estimated datum.	HFM 12	1	6	2.2.2.1	I1, I2	01, 02
4.2 When the tide gauge measurements are not immediately available, tide heights are predicted and then converted to corrections.	--	--	--	2.2.2.2	I1, I2	01
4.2.1 Predicted tide heights are acquired from tide tables:	HFM 13	1	6			
4.2.1.1 Through the use of harmonic constants and astronomical arguments	--	--	--			
4.2.1.2 Or through the use of time differences and heights ratios/differences	--	--	--			

TASK	HIHAN FUNCTION MODULE	MODULE INPUT	MODULE OUTPUT	STRUCTURAL ANALYSIS NODE	NODE INPUT	NODE OUTPUT
4.2.1.3 Either technique is applied to a standard port to predict heights (highs and lows) at the secondary port of interest.	--	--	--			
4.3 Co-tidal chart-range and co-tidal chart-time curves are used to extrapolate the tide correction for each sounding according to the time and position.	HFM 14	6	6	2.2	13 2	01
4.4 Where tidal prediction is the only available method for determining tidal corrections, updated Harmonic Components may be computed via Admiralty semi-graphic method with 30 days continuous remote tide gauge measurements or via other methods with less than 30 days data.	HFM 15	5	6	2.2.2.2	13 1	2
5.0 Soundings and position are processed to form edited data files for each sounding source (shipboard, soundboat, HALS).	--	--	--	2	1→6 16	02, 04
5.1 Establish edited ship position and time data file.	HFM 16 HODAS	25	2,8,7	2,3	11	01
5.1.1. Edit Short Range NAVAID (Range-Range, Range-Azimuth, Azimuth-Azimuth, Sextant) file.	--	--	--	2.3.1	11	1,01
5.1.1.1 Display NAVAID time/range as time series profile on CRT.	HFM 17 HODAS	25,28	2			
5.1.1.2 Look for spikes and jumps.	Manual	--	--			
5.1.1.3 Correct spikes and jumps.	HFM 18 HODAS	25,28	28			
5.1.2 Recompute short range NAVAID position and establish positions and time file.	HFM 19 HODAS	25,28	7	2.3.1	11	1,01
5.1.2.1 Compute track and speed from successive positions and display as time series on CRT.	HFM 20 HODAS	7	2			
5.1.2.2 Replace bad positions with interpolated positions. Plot all position files on CRT and evaluate; if not satisfied with results, recycle.	HFM 21 HODAS	1,7	2,7			
5.1.2.3 Plot track line on mylar using appropriate day color. Annotate start and end lines plus time at selected intervals along track.	HFM 22 HODAS	7	2			
5.1.3 Edit Medium Range NAVAID file.	--	--	--	2.3.1	12	2,02
5.1.3.1 Apply whole lane corrections.	HFM 23 HODAS	25	28			
5.1.3.2 Display NAVAID time/range as time series profile on CRT.	HFM 17	25,28	2			

TASK	HIHAN FUNCTION MODULE	MODULE INPUT	MODULE OUTPUT	STRUCTURAL ANALYSIS NODE	NODE INPUT	NODE OUTPUT
5.1.3.3 Look for spikes and jumps using CRT profile.	Manual	--	--			
5.1.3.4 Correct spikes and jumps.	HFM 18	1,25,28	28			
5.1.4 Recompute Medium Range NAVAID position and establish positions and time file.	HFM 19	25,28	7	2.3.1	12	2,02
5.1.4.1 Compute track and speed from successive positions and display as time series on CRT.	HFM 20	7	2			
5.1.4.2 Replace bad positions with interpolated position, plot all position files on CRT and evaluate; if not satisfied with results, recycle.	HFM 21	1,7	2,7			
5.1.4.3 Plot track line on mylar using appropriate day color. Annotate start and end lines plus time at selected intervals along track.	HFM 22	7	2			
5.1.5 If several lines of position are available, compute several positions and determine position by least squares.	HFM 24	7	7	2.3.1	1,2	03
5.1.6. Edit Loran C file.	--	--	--	2.3.1.4	11	1
5.1.6.1 Display NAVAID time difference/range as time series profile on CRT.	HFM 17	25,28	2			
5.1.6.2 Look for spikes and jumps using CRT profile and daily log from lane identification checks.	Manual	--	--			
5.1.6.3 Correct time difference/range file.	HFM 25 HODAS	1,28	28			
5.1.7 Recompute Loran C position and time and establish ocean track file.	HFM 26 HODAS	25,28	8	2.3.1.4	1	2
5.1.8 Add NAVSAT position and time to ocean track file.	HFM 27 HODAS	1	28,8	2.3.1.4	12	3
5.1.9 Adjust loran C track to satellite datum and add to ocean track file.	HFM 28	8,28	8	2.3.1.4	2,3	4,01
5.1.10 If digitized navigation not available, digitize from sounding journal and process as above.	HFM 29	1	7	2.3.1.4	11	1
5.1.11 Compute line miles of survey and send to Progress file.	HFM 30	7,8	29	2.3.1.4	4	02
5.2 Establish edited ship depth and time file.	--	--	--	2.3	12	02
5.2.1 Apply system corrections to sonar depth data.	HFM 31 HODAS	25	28	2.3.2	12,1	2
5.2.2 Plot depth data as time series profile on CRT and edit out spikes using the sonargram(s) as an aid (sonargram for ship and boat data).	HFM 32 HODAS	25,28	2,9	2.3.2	2,13	3

TASK	HIHAN FUNCTION MODULE	MODULE INPUT	MODULE OUTPUT	STRUCTURAL ANALYSIS NODE	NODE INPUT	NODE OUTPUT
5.2.3. Filter shipboard soundings and establish a ship-filtered depth file.	HFM 33 HODAS	9	30	2.3.2	14,3	01
5.2.3.1 Set filter control for swell removal or other.	--	--	--	--	--	--
5.2.4 If digital soundings are not available, digitize the echogram(s) and repeat the above steps.	HFM 34 HODAS	5	9	2.3.2	11	1
5.3 Establish edited soundboat position and time data files.	HFM 16	26	28,10	2.3	13	03
5.3.1 Process soundboat positions same as 5.1.1 through 5.1.5 of ship positions.	HFM 17-34	26	10	2.3.3	--	--
5.3.2 If digitized position data not available, digitize from soundboat journal and process as above.	HFM 29	1	10	--	--	--
5.3.3 Add additional annotation for each of four soundboat sources at start and end of track plot.	HFM 22	10	2	--	--	--
5.4 Establish edited soundboat depth and time file.	--	--	--	2.3	14	04
5.4.1. Process soundboat depths same as 5.2.1 through 5.2.4 of ship depth.	HFM 31-34	26	11,31	2.3.3	11	01,1
5.5 Establish edited LASER data file.	HFM 35 HALS	27	12	2.3	15,16	05
5.5.1 Generate laser environmental bias factors.	HFM 35	27	32	2.3.5	11	1
5.5.2 Edit NAVAID file.	HFM 35	32	32	2.3.5	12	2
5.5.3 Compute aircraft positions and establish a position and time file.	HFM 35	32	32	2.3.5	2	4
5.5.4 Compute sea surface corrections for laser depth.	HFM 35	32	32	2.3.5	13	3
5.5.5 Compute laser position on sea bottom and apply depth correction.	HFM 35	32	32	2.3.5	1,3,14	5
5.5.6 Compute a grid of depths representing a swath of depth data along the aircraft track and present correlating covariances and rejected densities.	HFM 35	32	12	2.3.5	4,5	01,03
6.0 Soundings and positions are selected for an interim sounding file and an overlay sheet for each data source (ship, soundboat, HALS, and historical) is prepared.	--	--	--	3	11 13	1,2
6.1 Shipboard Data File and Overlay:	--	--	--	3.1	11,12	01
6.1.1 Key in position limits of overlay sheet area and sheet scale.	HFM 36	1	28	--	--	--

TASK	HIHAN FUNCTION MODULE	MODULE INPUT	MODULE OUTPUT	STRUCTURAL ANALYSIS NODE	NODE INPUT	NODE OUTPUT
6.1.2 Computer makes limits larger than normal overlay and operator makes mylar larger so that adjacent or adjoining data can be evaluated at the same time.	--	--	--	--	--	--
6.1.3 Search all shipboard position and time file for segments within overlay bounds.	HFM 37	7	28	--	--	--
6.1.4 Display digitized depth and filtered depth as time series profile on CRT.	HFM 38	9,30,28	2,28	3.1.1	11→13	1
6.1.5 If more than one source at same time, plot second source on CRT.	--	--	--	--	--	--
6.1.6 Overlay CRT with a relative time scale template.	HFM 39	28	28	--	--	--
6.1.7 Operator evaluates display and selects sounding from the profile.	Manual			3.1.1	1	2
6.1.8 Operator keys in relative time and shipboard source for each sounding selected or computer selects soundings on evenly spaced time intervals and peaks and deeps; hydrographer then deletes unwanted data.	HFM 40,41,42	1,28	28	--	--	--
6.1.9 Computer converts relative template time to real file time and searches position file for correlating position and sends to overlay (time, position, depth) files.	HFM 43,44,45	28	28,13	3.1.1	2,14	3
6.1.10 Above operation continues until complete file has been searched.	--	--	--	--	--	--
6.1.10.1 Add best available tide corrections from TIDE file for temporary plot file only.	HFM 46	6,13	13	3.1.1	3,15	4
6.1.11 Plot contents of file on mylar overlay using blue pen.	HFM 47	13	2	3.1.1	4	01
6.1.12 Compute contours and plot contours on additional mylar overlay using blue pen.	HFM 47	13	2	3.1.1	4	02
6.2 Soundboat Data File and Overlay:	HFM 48	10,11	14	3.1	13,14	02
6.2.1 Key in position limits of overlay sheet area and sheet scale.	HFM 36	1	28	--	--	--
6.2.2 Computer makes limits larger than normal overlay and make mylar overlay larger so that adjacent or adjoining data can be evaluated at the same time.	--	--	--	--	--	--
6.2.3 Search soundboat positions and time file for segment within overlay plot.	HFM 37	10	28	--	--	--
6.2.4 Display digitized depth and filtered depth as time series profile on CRT.	HFM 38	11,31	2,28	3.1.2	11→13	1

TASK	HIHAN FUNCTION MODULE	MODULE INPUT	MODULE OUTPUT	STRUCTURAL ANALYSIS NODE	NODE INPUT	NODE OUTPUT
6.2.5 Overlay CRT with a relative time scale template.	HFM 39	28	28			
6.2.6 Operator evaluates display and selects filtered or raw soundings for overlay plot.	Manual			3.1.2	1	2
6.2.7 Operator keys in relative template time for each sounding selected and code for filter or raw, or computer selects soundings at evenly spaced time intervals and peaks and deeps; hydrographer then deletes unwanted data.	HFM 40,41,42	1,28	28	--	--	--
6.2.8 Computer converts relative time to real time and searches position file for correlating position and sends to overlay (time, position and depth) files.	HFM 43,44,48	28	28,14	3.1.2	2,14	3
6.2.9 Above operations continue till complete file from as many as four soundboats has been searched.	--	--	--	--	--	--
6.2.9.1 Add best available tide corrections from TIDE file for temporary plot file only.	HFM 46	6,14	14	3.1.2	3,15	4
6.2.10 Plot contents of plot file on mylar overlay using red pen.	HFM 47	14	2	3.1.2	4	01
6.2.11 Compute contours and plot contours on additional mylar overlay using a red pen.	HFM 47	14	2	3.1.2	4	02
6.2.12 Where multiple coverage from soundboats is available sort file via soundboat code and plot individually.	HFM 47	14	2	--	--	--
6.3 HALS Data File and Overlay:	--	--	--	3.1	15,16	03
6.3.1 Key in position limits of overlay sheet area and sheet scale.	HFM 36	1	28	--	--	--
6.3.2 Computer makes limits larger than normal overlay and operator makes mylar overlay larger so that adjacent or adjoining data can be evaluated at the same time.	--	--	--	--	--	--
6.3.3 Search HALS position and time file for segment within overlay bounds.	HFM 37	12	28	--	--	--
6.3.4 Compute contours for the depth, covariance, and rejects for the data swath, and then display on CRT for evaluation.	HFM 49,50	12	2	3.1.3	11,12	1
6.3.5 Present simultaneously on CRT three rectangular grid displays: depth, covariance, and rejects.	HFM 51	12	2	3.1.3	1	2
6.3.6 Overlay CRT with a numbered grid template 12 by 120.	HFM 52	28	28	3.1.3	13	3,02
6.3.7 Operator evaluates display and selects soundings for overlay plot.	Manual	--	--	---	--	--
6.3.8 Operator keys in local grid coordinates 12 by 120 for each sounding selected or computer selects peaks and deeps.	HFM 53,54	1,12	28	3.1.3	2,13	4

TASK	HIHAN FUNCTION MODULE	MODULE INPUT	MODULE OUTPUT	STRUCTURAL ANALYSIS NODE	NODE INPUT	NODE OUTPUT
6.3.9 Computer converts local grid to position and loads depth and position into overlay file.	HFM 55,56	28	15	3.1.3	4	5,03
6.3.10 Depending on sheet scale, computer will load additional depths and positions to fill in chart.	HFM 57	28	15	--		
6.3.11 Above operation continues until all HALS files are searched. Add best available tide correction from TIDE file for plot file only.	HFM 46	6,15	15	3.1.3	4	5,03
6.3.12 Plot contents of file on mylar overlay using a green pen.	HFM 47	15	2	3.1.3	5	04,05
6.3.13 Compute contours and plot contours on additional mylar overlay using green pen.	HFM 47	15	2	3.1.3	5	04,05
6.4 Historical Data Overlay:	--	--	--	3.1	17	04
6.4.1 Key in position limits of overlay sheet area and sheet scale.	HFM 58	4	16	3.1.4	11,12	1
6.4.2 Make limits larger than normal overlay and make mylar overlay larger so that adjacent or adjoining data can be evaluated at same time.	HFM 36	1	28	--	--	--
6.4.3 Search Historical Data Base File for segments within overlay bounds.	HFM 37	4	28	--	--	--
6.4.4 Load depth and position into Historical overlay file.	HFM 58	28	16	3.1.4	1, 13	2
6.4.5 Plot contents of file on mylar overlay using black pen.	HFM 47	16	2	3.1.4	2	01
6.4.6 Compute contours and plot contours on additional mylar overlay using black pen.	HFM 47	16	2	3.1.4	2	02
7.0 Overlays are manually compared where source files overlap to evaluate data consistency and are compared to historical data from the same area and from surrounding area.	Manual	--	--	3	1,2	3,01
7.1 Each source is evaluated independently by first observing where a whole track may indicate the soundings at crossings to be inconsistent.	Manual	--	--	3.2	11	1,2
7.2 Each source is compared with another source and evaluated for consistency at overlap areas.	Manual	--	--	3.2	1	3,4
7.2.1 Where large differences are detected, the reasons for the differences must be determined or the survey redone.	--	--	--	3.2	2,3	5,01
7.3 Historical data is evaluated to ensure completeness; if historical data is recent, overlap should agree.	Manual	--	--	3.2	4,5	02

TASK	HIHAN FUNCTION MODULE	MODULE INPUT	MODULE OUTPUT	STRUCTURAL ANALYSIS NODE	NODE INPUT	NODE OUTPUT
8.0 Soundings are selected by area from any of the three interim sounding files to begin preparation of a Field Sheet File; each selected sounding carries a source code, time, depth, position, and an indication of position quality/survey scale.	HFM 59	13,14,15	21	3	3	4
8.1 Fasten mylar overlay to digitizer table.	Manual	--	--	--	--	--
8.2 Select soundings by area to input to the Field Sheet File.	Manual	--	--	3.3.1	11,12	1,2
8.3 Key in source code and layout area with digitizer pen to selected data areas.	HFM 60	1,5	28	--	--	--
8.4 Computer searches soundboat file for position and depth of soundings within the designated area and transfers that data to the Field Sheet File.	HFM 61,62,63	13,14,15	21	--	--	--
8.5 Add positions and soundings from ADJOIN File, if already established, to the Field Sheet File.	HFM 64	17	21	3.3.1	2,14	02
8.6 Key in delete code and touch with digitizer pen to remove data from area.	HFM 65	1,5,21	21	--	--	--
8.7 Process all interim sounding files (ship, soundboat, and HALS) in the above manner until a complete Field Sheet File is established. Add best available tide correction from TIDE File for temporary plot file only.	HFM 66,67,68 HFM 69	13,14,15 6,21	21 21	--	--	--
8.8 The above selection process is implemented via CRT where each is displayed in sections as an option.	HFM 70	21	2	--	--	--
8.9 Plot Field Sheet File:	HFM 71	21	2	3.3	1	2
8.9.1 Plot Track on a separate sheet from soundings.	HFM 72	21	2	--	--	--
8.10 Compute contours and plot.	HFM 73	21	2	3.3	2	3
8.11 Evaluate Field Sheet File results and cycle as above to add or delete data from the Field Sheet File.	HFM 74	1,21	28,21	3.3	2,3	4
8.12 Load adjoining data onto ADJOIN File, and reduce Field Sheet File to proper limits.	HFM 75,76	1,28,21	28,17	3.3	4,13	03,04
8.13 Tabulate number of selected soundings used from each source and add to PROGRESS File.	HFM 77	1,21,28	29	3.3.1	1,13	01
9.0 Side Scan Sonar data traces are scanned during survey operations for detection, quantification, and identification of Dangers to Navigation. When a target is visually observed and checked, a target list file is entered with time and target measurements. For selected targets, position coordinates and target height and depth are computed, and a swath sheet plot prepared.	--	--	--	3.4.1	11	1

TASK	HIHAN FUNCTION MODULE	MODULE INPUT	MODULE OUTPUT	STRUCTURAL ANALYSIS NODE	NODE INPUT	NODE OUTPUT
9.1 Targets are kept sorted and identified via the swath sheet plot. When further investigation is indicated, additional Side Scan Sonar passes over the same target are added to the target list. After evaluation, identifying code and position are added to a SYMBOLS File.	HFM 78	1	18	--	--	--
9.2 Survey review items as indicated in Section 1.5.6.5 are investigated and, when verified, are added to the SYMBOLS File.	HFM 79	1	18	--	--	--
10.0 Shoreline is evaluated, modified, and added to the Field Sheet File where applicable.	--	--	--	3.4	14,15	2
10.1 Search Historical Data Base File for shoreline and create a SHORE File.	HFM 80,81	4,28	28,19	3.4.2	11	1,01
10.2 Plot SHORE File on mylar sheet.	HFM 82	19	2	3.4.2	11	1,01
10.3 Cover laser data overlay with shoreline sheet and evaluate.	Manual	--	--	3.4.2	11	1,01
10.4 If new source material available for shoreline (photographs, land surveys, boat shoreline surveys, etc.), then construct new shoreline manually with new data plotted over Historical data.	Manual	--	--	3.4.2	12,1	02
10.5 Digitize new shoreline and create a new version of the SHORE File.	HFM 83	1,5	19	3.4.2	12,1	02
10.6 Add SHORE File to Field Sheet File.	HFM 84	1,19	21	3.4	2,3	01
11.0 Aids to Navigation, water quality, current, and bottom sediment are investigated and added to the SYMBOLS File, and then are added to the Field Sheet File.	--	--	--	3.4	11→13	1
11.1 Search Historical Data Base File for Aids to Navigation, verify aids and enter in SYMBOLS File.	HFM 85	4	28	3.4.1	12→14	2
11.2 Search survey manuscripts and sounding journal for new and verified Aids to Navigation, water quality, current, and bottom sediment classification.	Manual	--	--	3.4.1	12→14	2
11.3 Key in position and identifying code to SYMBOLS File.	HFM 86	1	18	3.4.1	2	3
11.4 Add SYMBOLS File to Field Sheet File.	HFM 87	1,18	21	3.4	16	3
12.0 An ANNOTATION File is created and added to the Field Sheet File. Templates, titles, control information, graphics, sheet limits, and adjoining sheet numbers are all added to the Field Sheet File.	HFM 88,89	1,28	20	3	16,5	6,02
12.1 Key in adjoining sheet numbers, title, and horizontal control, and add to ANNOTATION File.	HFM 90	1,28	28,20	3.4	11	1

TASK	HIHAN FUNCTION MODULE	MODULE INPUT	MODULE OUTPUT	STRUCTURAL ANALYSIS NODE	NODE INPUT	NODE OUTPUT
12.2 Field Sheet template: key in Archive number, sheet number, surveyed by, year, projection, scale, grid, spheroid, geodetic datum, sounding datum, vertical datum, latitude and longitude of tide reference station, track sheet number, and add to ANNOTATION File.	HFM 91	1,28	28,20	3.5	12,1	1
12.3 Graphic for field sheet layout: read in general shoreline from data bank, key in station position and coordinates of all sheets, and add to ANNOTATION File.	HFM 92	1,4,28	20	3.5	13,1	1
12.4 Work record: key in name of the persons who created the Field Sheet File and the names of checkers, the SNS check, and add to the ANNOTATION File.	HFM 93	1,28	20	3.5	14,1	2
12.5 Add ANNOTATION File to Field Sheet File.	HFM 94	1,20	21	3.5	15,2	01
13.0 CoHFM 95 of Field Sheet File is first viewed on the CRT for editing possible overlap among symbols and soundings, and is then plotted to create a field sheet copy.	21	2		3	6,17	03
13.1 SYMBOLS for Aids and Dangers to Navigation take precedence over soundings and contours; soundings and contours are deleted when overlap occurs.	HFM 96	1,21	21	3.6	11	1
13.2 Soundings take precedence over all other symbols except symbols for Aids and Dangers to Navigation; symbols representing current, bottom sediment, etc., are slightly repositioned to prevent overlap.	HFM 97	21	21	3.6	11	1
13.3 When overplots or crowding occur, return to Section 8.6 and delete data.	--	--	--	3.6	1	2,01
13.4 Add tide corrections from the TIDE File to the Field Sheet File and plot a Field Sheet copy for evaluation.	HFM 98,99	6,21	2	3.6	2,12	3,02
14.0 Field Sheet Copy, Field Sheet File, and copies of raw data and all files are sent to NAVOCEANO as Field Sheets are completed.	Manual	--	--	--	--	--
14.1 Duplicates of files needed for shipboard current tasks are retained.	HFM 100	Any	Any	--	--	--
14.2 Send files to NAVOCEANO.	Manual	--	--	--	--	--
14.3 Safety file copies are retained onboard to ensure safe transit.	Manual	--	--	--	--	--
15.0 Detachment continues survey until requirements are satisfied or new tasks are assigned.	Manual	--	--	--	--	--
16.0 Files from the Hydrographic Survey Detachment are collected and evaluated at NAVOCEANO. If non-HODAS data is to be incorporated or used exclusively, the non-HODAS data is introduced here.	HFM 101,102	33,21	28	4.1	11	1, 3

TASK	HIHAN FUNCTION MODULE	MODULE INPUT	MODULE OUTPUT	STRUCTURAL ANALYSIS NODE	NODE INPUT	NODE OUTPUT
16.1 Compute number of line miles surveyed, number of soundings selected, and number of symbols entered.	HFM 103	29,33,21	28,29	4.1	11	1
16.2 Evaluate survey line spacing.	Manual	--	--	4.1	11	2
16.3 Evaluate fix intervals and NAVAID quality.	Manual	--	--	4.1	11	3
17.0 Geodetic quality of survey is evaluated.	Manual	--	--	4.1	1→3	01
17.1 If quality is poor, redo geodetic survey (in practice evaluation is done early in survey.	Manual	--	--	--	--	--
18.0 Geodetic control data base is updated.	Manual	--	--	4.1	1 3, 12	02
19.0 A new Tide File is created from a computed datum based on 30 or more days of observed tide and input from observed tidal heights and/or from the best possible office computer predicted tidal information when applicable.	HFM 104	1,5	6	4	13,14	2
19.1 Compute tide datum.	HFM 12	1	6	4.2	11,12	1
19.2 Compute harmonic components.	HFM 15	5	6	4.2	1.11,12	2
19.3 Use measured tide as in Section 4.1 or compute tide height via prediction techniques.	HFM 11,13	1,5	6	4.2	1,11,12	2
19.4 Convert tide height to tide correction.	HFM 14	6	6	4.2	2	01
20.0 If desired, soundings are reprocessed to form edited data file for each sounding source (ship, soundboat, and HALS).	--	--	--	4.3	11	1,2
20.1 Establish edited ship position and depth file using identical operations as in Section 5.1 and 5.2 covering shipboard processing.	HFM 16-34	25	7,9	2.3	11,12	01,02
20.2 Establish edited soundboat position and depth data files using identical operations as in Section 5.3 and 5.4 covering soundboat processing.	HFM 17-34	26	10,11	2.3	13,14	03,04
20.3 Establish edited laser data file using identical operations as in Section 5.5 covering shipboard processing.	HFM 35	27	12	2.3	15,16	05
20.4 Observed tide data is substituted for predicted tide in the tide file.	HFM 11	1,5	6	--	--	--
20.5 Where non-HODAS data is involved, establish edited Other data files similar to operations indicated in Section 5.0.	HFM 105	33	22,23	--	--	--

TASK	HIHAN FUNCTION MODULE	MODULE INPUT	MODULE OUTPUT	STRUCTURAL ANALYSIS NODE	NODE INPUT	NODE OUTPUT
21.0 If desired, soundings are reselected for a new interim sounding file and a video and mylar overlay sheet for each data source (ship, soundboat, HALS) is prepared.	HFM 36-48	As Required		4.3	1,2	3
21.1 DATA Files and mylar overlays are prepared identical to shipboard processing operations as seen in Section 6.	HFM 36-48	As Required		3	11→13	1,2
21.2 If non-HODAS data is available, establish Other data files and overlays.	HFM 106	22,23	24	--	--	--
21.3 To display contours and soundings via video display, send files to the CRT instead of the plotters.	HFM 107			--	--	--
21.4 Video screen displays only sections of a large scale chart area, since it is size and pixel limited, but "ZOOM" display features are included.	HFM 108	28	2	4.3	3,12,13	01
22.0 New video and mylar interim overlays or field-prepared interim overlays are where source files overlap to evaluate data consistency and are compared to historical data from the same areas or from surrounding areas.	Manual	--	--	4.3 3	3,12,13 1,2	01 3,01
22.1 Mylar or video overlays are covered with a numbered grid overlay.	Manual	--	--	--	--	--
22.2 Select source and grid area of files to be viewed.	Manual	--	--	--	--	--
22.3 Key in source code and overlay grid coordinates of desired view.	HFM 109	1,13,14, 15,16	2	--	--	--
22.4 Residuals are computed and contoured for overlap areas and viewed on CRT.	HFM 110	1,13,14 15,16	2	--	--	--
22.5 Multiple subplots are stacked and displayed.	HFM 111	1,13,14, 15,16	2	--	--	--
22.6 Using "DISPLA" techniques, the operator will set up and view portions of the interim sounding files creating 2-D or 3-D views, stacked views, or rotated views.	HFM 112	13,14, 15,16	2	--	--	--
22.7 The primary purpose for video display is to validate source information contained in the interim sounding files and aid in source selection. Essentially the video graphics are intended to validate what is contained in the interim sounding file.	Manual	--	--	--	--	--
23.0 Soundings are selected from the Field Sheet File or by area from any of the three interim sounding files to begin preparation of a Smooth Sheet File; soundings are corrected for tide and datum via the new TIDE File.	HFM 113	6,21	34	4.4	11→4	1,2,01

TASK	HIHAN FUNCTION MODULE	MODULE INPUT	MODULE OUTPUT	STRUCTURAL ANALYSIS NODE	NODE INPUT	NODE OUTPUT
23.1 When soundings are selected from the Field Sheet File, tide corrections are applied by correlating time and position of source and applying corrections from the Tide File with respect to the co-tidal range and time difference charts.	HFM 113	6,21	34	4.4 4.4.1	1,14 11	2 1
23.2 After correction, Field Sheet File soundings are (if selected) sent directly to the Smooth Sheet File.	HFM 113	6,21	28	--	--	--
23.3 When selection is to be from the three interim sounding files, procedure as indicated in Section 8.0 is applied except that soundings selected are transferred to the Smooth Sheet File.	HFM 59-77	As Required	34	4.4.1	1,12	2
23.4 Where non-HODAS data are to be merged with Hydrographic Detachment data, additional interim data files are available.	HFM 114	24	34	4.4.1	1,2,13	3,01
23.5 Where no Hydrographic Detachment data is available, the non-HODAS data will be processed using procedures defined in Section 8.0, directly creating Smooth Sheet Files with no field sheet file in the interim.	HFM 59-77	33	34	4.4.1	1,2,13	3,01
23.6 Interplay between operations of Section 23.0 and Section 22.0 are necessary when sounding selection is made at this level.	--	--	--	--	--	--
23.7 As indicated via operations in Section 8.0, the resulting Smooth Sheet File will be plotted as soundings and as contours on mylar; an additional mylar sheet will be prepared by changing plot pen colors in accordance with contour interval and plotting soundings in different colors for evaluation.	HFM 115	34	2	4.4.1	3	02,03
23.8 The soundings plotted from the Smooth Sheet File resulting from these operations are the final version of the soundings that will go on the final Smooth Sheet.	--	--	--	--	--	--
24.0 Symbols representing Dangers to Navigation from the Field Sheet File are added to the Smooth Sheet File or the side scan sonar traces are scanned for verification, quantization, and identification of Dangers to Navigation; a new SYMBOLS file is created and added to the Smooth Sheet File.	--			4.4.3	11,12	1,2,3, 01
24.1 The SYMBOLS File may be taken directly from the Field Sheet File and added to the Smooth Sheet File or the SYMBOLS File may be edited and then added to the Smooth Sheet File.	HFM 116	21	34	4.4.3	11	1,2
24.2 If a new SYMBOLS file is desired, review side scan sonograms and establish a new target list, then follow identical operations as indicated in Section 9.0 and load results into the Smooth Sheet File.	HFM 78,79	1	18	4.4.3	12	3,01
25.0 Shoreline from the Field Sheet File is added directly or edited and added to the Smooth Sheet File or a new shoreline is constructed, digitized, and added to the Smooth Sheet File.	--	--	--	4.4	3,11,16	4

TASK	HIHAN FUNCTION MODULE	MODULE INPUT	MODULE OUTPUT	STRUCTURAL ANALYSIS NODE	NODE INPUT	NODE OUTPUT
25.1 The shoreline file may be taken directly from the Field Sheet File and added to the Smooth Sheet Fileor the shoreline file may be edited and then added to the Smooth Sheet File.	HFM 117,118	1,5,21	34	4.4.4	11	1,2,01
25.2 If a new SHORE file is desired, follow identical operations as indicated in Section 10.0 and load results into the Smooth Sheet File.	HFM 81-84	1,5,21	34	3.4	14,15	2
26.0 Aids to Navigation, water quality, current, and bottom sediment classification from the Field Sheet File are added to the Smooth Sheet File or are investigated, a new file is created and added to the Smooth Sheet File.	--	--	--	4.4.3	11,12	1,2,3, 01
26.1 The Aids to Navigation water quality, current, and bottom sediment classification may be taken directly from the Field Sheet File and added to the Smooth Sheet File.	HFM 116	21	34	4.4.3	11	1,2
26.2 If a new SYMBOLS file is desired, follow operations as indicated in section 11.0 and load results into the Smooth Sheet File.	HFM 78,79	1	18,34	4.4.3	12	3,01
27.0 An ANNOTATION File is created and added to the Smooth Sheet File. Templates, titles, control information, graphics, sheet limits, and adjoining sheet numbers are all added to the Smooth Sheet File.	HFM 119, 88,89	1,21	20,34	4.4	4,17	5
27.1 Key in adjoining sheet numbers, title, and horizontal control and add to ANNOTATION File.	HFM 90	1,28	28,20,34	3.5	11	1
27.2 Smooth Sheet template: key in Archive number, sheet number, surveyed by, year, projection, scale, grid, spheroid, geodetic datum, sounding datum, vertical datum, latitude and longitude of tidal reference station, track sheet number, and add to ANNOTATION File.	HFM 91	1,28	28,20,34	3.5	1,12	1
27.3 Graphic for Smooth Sheet layout: read in general shoreline from data bank, key in station position, and coordinates of all smooth sheets and add to ANNOTATION File.	HFM 92	1,4,28	28,20,34	3.5	1,13	1
27.4 Work record: key in name of persons who created the Smooth Sheet File and the names of checkers, the SNR check, and the reviewer and add to the Annotation File.	HFM 93	1,28	20	3.5	1,14	2
27.5 Add ANNOTATION File to Smooth Sheet File.	HFM 94	1,20	34	3.5	2,15	01
28.0 Contents of Smooth Sheet File are viewed on the CRT for editing possible overlap among symbols and soundings, and then are plotted to create a Smooth Sheet copy.	--	--	--	4.4	5	02
28.1 Check coverage and completeness.	Manual	--	--	4.4.6	11	1
28.2 Check for overplots and crowding using procedures described in Section 13.	HFM 95-97	34	34	4.4.6	1	01

TASK	HIHAN FUNCTION MODULE	MODULE INPUT	MODULE OUTPUT	STRUCTURAL ANALYSIS NODE	NODE INPUT	NODE OUTPUT
29.0 Smooth Sheet File and oficially signed Smooth Sheet copy are forwarded to DMA, data files are retained in NAVOCEANO's data base.	--	--	--	4	4	04
29.1 Add Smooth Sheet File to Historical Data File.	HFM 120	34	3	4.5	11	01
29.2 Duplicate Smooth Sheet Copy and send to archives.	HFM 100	Any	Any	4.5	12	02
29.3 Duplicate interim files for partially completed Smooth Sheets and save.	HFM 100	Any	Any	--	--	--
29.4 Send Smooth Sheet File and Smooth Sheet copy to DMA.	Manual	--	--	--	--	--
29.5 Send Data files to NAVOCEANO's data base.	HFM 121,122	All	35	4.5	13	03

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